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[OFFICIAL NOTICE.]

Twenty-Third Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., April 9, 1900.

The twenty-third annual meeting of the Western Gas Association will be held in Chicago, May 16, 17 and 18, 1900, and will be called to order by the President, Mr. Wm. McDonald, of Albany, N. Y., at 9:30 A. M., Wednesday, May 16th.

The Auditorium Hotel has been selected as headquarters, and the meetings will be held in a suitable room contained therein. The following rates have been obtained for members and any who may attend the meeting:

European Plan.—$2.50 per day and up; two, in one room, $1.50 per day each, and up; room with bath, one person, $3.50 per day; two persons, $5.

American Plan.—$4 to $5 per day.

The Executive Committee has arranged for the presentation of the following papers:

"Candle Power: Its Present Relation to the Gas Industry;" by Mr. Jno. R. Lynn, Portsmouth, Ohio.

"The Operation of a Central Station Electrical Plant with a Gas Engine;" by Mr. J. C. Small, Aurora, Ind.

"Public Control of Rates;" by Mr. Geo. McLean, Dubuque, Iowa.

"The Systematic Location of Gas Mains as Opposed to a Conduit;" by Mr. Donald McDonald, Louisville, Ky.

"Temperatures in Condensation;" by Mr. W. H. Barthold, Grand Rapids, Mich.

"Regenerative Benches;" by Mr. Howard C. Slater, Milwaukee, Wis.

"Monthly Technical Report of Operations in Coal Gas Works;" by Mr. W. E. Steinwedell, Belleville, Ills.

"The Hygienic Effect of the Use of Gas;" by Mr. Thos. D. Miller, Dallas, Texas.

"Wrinkle Department;" Edited by Mr. Fred. H. Shelton, Philadelphia, Pa.

Reports will be received from the Committee on Cyanides and from the Committee on Isolated Generators for Bench Firing. Mr. Somerville will present a "Short Topic" relating to an experience in telescoping a gas holder.

The Western Passenger Association, from points in Eastern and trans-Missouri territories, Central Passenger Association, Trunk Line Association, Southeastern Passenger Association, Wisconsin Central Lines, Chicago, Rock Island and Pacific Railway Company and the Chicago and Alton Road, have granted rates of one and one-third fare for the round trip, conditioned on 100 certificates being presented to the Secretary for indorsement. The territory embraced by the above Associations includes all State divisions east of the Mississippi river, except New England. The following States and Territories west of the Mississippi river are in the territory covered by the Railway Associations granting reductions: North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Indian Territory, Colorado and Utah.

All persons attending the meeting will purchase a first-class ticket at starting point, paying full fare for same, obtaining from agent a certificate stating that the person whose signature appears on same has purchased, at full tariff fare, one first-class ticket to Chicago, which certificate, after it has been signed by the Secretary of the Association and a representative of the above Passenger Associations, will entitle the purchaser to a one third rate returning home.

Apply to ticket agent at least 30 minutes before departure of train. All station agents do not have a supply of certificates, but they can be obtained by request, if notification is made in time. Persons outside the territory embraced by the Passenger Associations mentioned above should purchase a ticket to nearest point within one of said Association, and from there purchase a ticket to Chicago, obtaining a certificate which will, if properly endorsed in Chicago, entitle them to a one-third fare returning to place from which certificate was obtained, provided it is endorsed by a representative of the Passenger Associations, who will be present at the meeting, and the undersigned.

Those who live in Western Passenger Association territory should consult local agents several days in advance of purchasing ticket to Chicago, in order to reach an understanding with the different roads as to the junction point via which they will make rates applicable. Some local agents sell to junction points, where delegates can re-buy to destination. Certificates held by wives of the delegates attending the meeting will be honored in the same manner as those held by the delegates themselves.

A beefsteak dinner, to be provided by the Association, will be held Thursday evening, at the Chicago Athletic Club, tickets for which will be sold at $5 each. While the ladies will not participate in the dinner, arrangement will be made for their entertainment.

As it is necessary that arrangements for this dinner should be perfected at an early date, it is requested that all those who expect to attend the meeting will notify Mr. H. D. Harper, Chicago, Ills., of the Committee, as early as possible of the number of tickets they will require.

All queries sent to the Secretary for the Question Box will be assigned, in advance of the meeting, to members for answer.

The Secretary will be pleased to answer any communication pertaining to the meeting, and will mail blank applications to any who desire to become members of the Association. JAMES W. DUNBAR, Secy.

BRIEFLY TOLD.

THE TWENTY-THIRD MEETING OF THE WESTERN GAS ASSOCIATION.—Secretary Dunbar informed us last week that nothing more could be said respecting the twenty-third meeting of the Western Gas Association, in so far as the preliminaries thereof are concerned, than had been given in the official notice that was originally prepared by him for publication. That intimation means that the work of the officers and of the committees interested with the task of preparation was thoroughly done, as is the rule when the Western Association has anything to do. Looking over the official notice, it is with satisfaction one notes that the twenty-third meeting of the Western is not to lack for matter in the shape of papers to cause its sessions to be uninteresting from a technical point of view. Quite to the contrary, the paper list is of rare promise, if one may predict from the titles what the contents may be. Another noteworthy point in connection with the list is that, of the eight papers promised, four are to be from authors who this year will make their initial effort as such before any Association. That fact alone speaks well for the pertinacity of the officers in their quest for contributors, and speaks equally well for the fraternal spirit shown by the contributors. In addition to the set paper numbers must be considered the President's Address and Wrinkle Department as incentives to active discussion during the business hours. President McDonald is never verbose, but is always able to explain himself in language that shows simply and logically how close to current times in the gas business he keeps himself, so we may all look for something from him that will be of interest and of value. The "wrinkle" end of the programme is also in thoroughly capable charge, and it needs but the naming of Editor Shelton to prove that what we say is so. The social plans have been carefully matured, and while the beefsteak dinner to be set out at the Chicago Athletic Club on the night of the 17th inst. is billed most prominently, the members and guests may rest content that there will be more than that, "before and after." Regarding the dinner, it is hoped that Secretary Dunbar's request, to those proposing to share therein, for ample notification to Mr. H. D. Harper, has been heeded. The selection of headquarters could not possibly be improved upon, and a word, to the effect that those who would be comfortably housed are best housed when their accommodations are secured in advance, may not here be amiss. The signs are that the next Chicago meeting will be quite up to the Western's record from an attendance point of view.

NOTES.—A very successful order of demonstration lectures on the art of cooking by gas was completed in Toledo, O., the week ending April 14th. The lectures were carried on under the auspices of the Toledo Gas Appliance Exchange, with which useful local institution Mr. F. R. Persons has much to do. The lecturess was Mrs. Alice Carey Waterman, of Chicago, who does her work with thoroughness, and convincingly. Six lectures were given, each commencing at 2 P.M., and lasting to 5 P.M., of the days in the week named. The attendance was excellent and that the results were satisfactory goes without saying. ——Mr. George W. Beck, Superintendent of the Sunbury (Pa.) Gas Company, has been authorized to notify the residents that, beginning the 1st inst., the following selling rates are to prevail: To those using 2,000 cubic feet and less per month, $1.65 gross, $1.50 net; over 2,000 and less than 5,000, $1.25 net; over 5,000 and less than 10,000, $1.15 net; over 10,000, $1 net. The discounts are allowed on bills paid within 15 days.——The Orange County Gas and Electric Company, to furnish gas and electricity for Middletown, Orange county, N. Y., has been incorporated by Messrs. Edwin T. Hanford, F. P. S. Crane, George A. Swayzee, H. M. Hayes and John H. Galloway. It is capitalized in $300,000.——The proprietors of the Ypsilanti (Mich.) Gas Company propose to rebuild that plant this season.——The Chester Gas Company, of Delaware County, Pa., has declared a dividend of 4 per cent.——Mr. G. G. Atkinson, Manager of the Goshen (Ind.) Gas Company, proposes to put that concern on a paying basis. To do this, he says, means the reconstruction of the plant, and those who know its circumstances are likely to agree with him.——The gist of the report of the committee named to arrange terms for the merging of the Welsbach Light Company and the Welsbach Commercial Company, as reported in a recent issue of the Philadelphia *Record*, is as follows: "That a new Company be organized with an authorized capital stock of $3,500,000 and an authorized issue of $7,000,000 of 30-year sinking fund 5 per cent. gold bonds, subject to call at par and accrued interest for sinking fund purposes, secured by mortgage upon all its property, including stocks acquired under this plan of reorganization, with a sinking fund provision of $105,360 per annum. That the new Company buy the shares of the Welsbach Light Company not owned by the Welsbach Commercial Company, and the common and preferred shares of Welsbach Commercial Company, and pay therefor as follows, viz.: For each share of Welsbach Light Company, $60 at par in said bonds; for each preferred share of Welsbach Commercial Company, $100 at par in said bonds; for each common share of Welsbach Commercial Company, $100 at par in the stock of the new Company. The balance of the bonds not required to carry out the plan, amounting to $409,000 at par, should be certified and delivered only as required hereafter, under proper restrictions to be contained in the mortgage for the conduct or extension of its business, the construction, enlargement, alteration and betterment of works, the acquisition of property, real or personal, or for working capital."

[Prepared for the Journal.]

Some Mechanical Wrinkles for Gas Engineers.

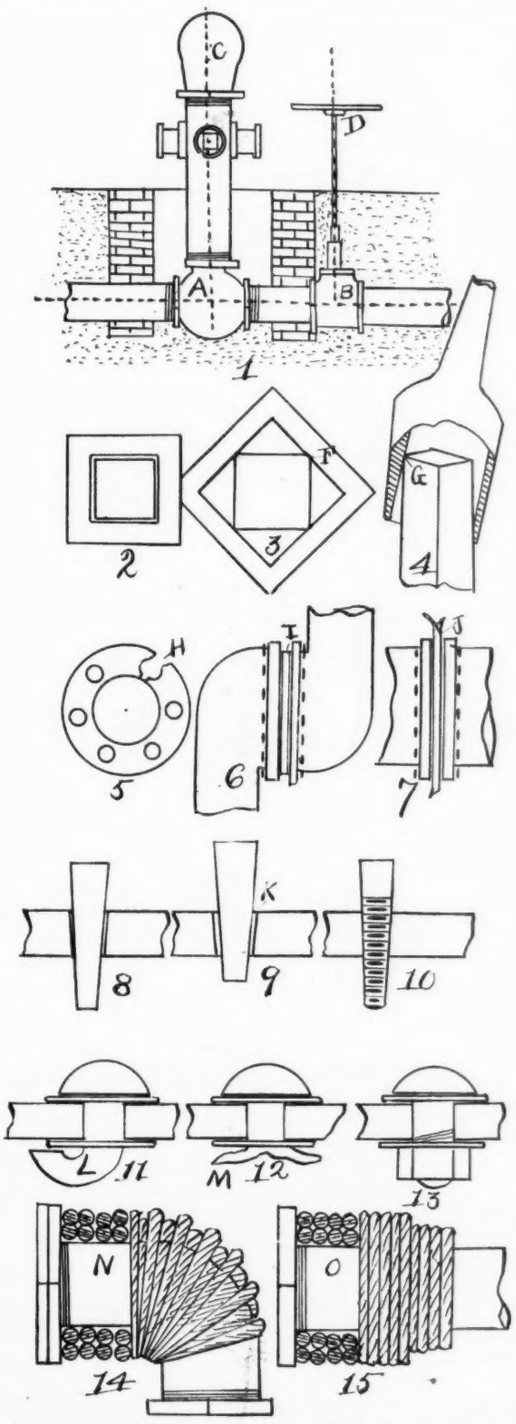
By MR. GEORGE D. RICE.

Concerning Fire Protection.—Around gas works, and places where gas is handled in any form, it is of course very important that the fire protection be adequate. When putting in fire protection for gas works careful attention should be given to the several important details of the fire protective service, and in this article a few of the leading points connected with the hydrants and pipe connections will be considered. As to the hydrant piping, all of this should be laid underground, if possible, and every means taken to prevent its exposure to frost and the elements of the weather in general. If for sprinklers, the piping should be of the regular standard water works pipe of cast iron, bell and spigot pattern, tar coated and with leaded joints. This sort of connection will stand the effects of the climate and of the dampness from the earth for a very long time, while other descriptions are liable to become weak and lose their effectiveness in time. In case the pipe is not laid underground, for, of course, there will be many places where the piping and the connections, as well as some of the fixtures, must be above ground, it should always be of wrought iron and have screw thread joints. If it is not practicable to have screw-thread joints then they should be flanged.

Adjustment of the Hydrant.—In Fig. 1 is shown a plan of the hydrant and its connections for the purpose of illustrating two or three little points which are frequently overlooked by the engineers, and which often result in putting the hydrant out of service or rendering it non-effective at a time when most needed. Take the lines of dots, starting at *A* for illustration. Here is the common center, and from this point the hydrant and the pipes should branch in a perfectly true alignment. Often the writer has found the alignment so far out of uniformity that the workings of the hydrant have not only been affected, but the joints in the pipes have been so strained that leakage has occurred. From the point *A*, in the cut, the line may be extended to the point *C*, at the bell top, and the center of this should be set precisely over the center of the point *A*. If the same inclines to the right or to the left, or in any other direction, several parts of the hydrant will not come true, and if an attempt is made to bring the other piping true with this center standpipe out of line, the complications will increase, and sometime, when likely the service is most needed for fire purposes, the hydrant will fail. The next point to take measurements to is at *B*. The writer has often found this point depressed two or three inches below the correct level, with the result that the shaft of the gate is thrown to one side, at *D*. This makes it difficult to operate the gate of the hydrant, and in case of emergency, when there is fire and everybody is in haste, the gate shaft is liable to be wrenched and broken, thus throwing the hydrant out of use for the time being. The remedy consists in taking the proper measurements and in lining up the hydrant and all of its connections according to the correct rules of adjustment.

When the parts are untrue and an attempt is made to rectify them by straining and twisting the joints, the latter are in danger of being opened and at least weakened; therefore, the hydrant should not be trued in this way. If necessary all of the joints should be opened by unscrewing the thread work and a new start made with the hydrant, setting and properly adjusting each part until the complete outfit is evenly placed.

Examine the Sockets and Headpieces of Gate Stem.—When a hydrant first arrives from the manufacturers, the keys for turning the gate shafts are perfectly true and the sockets fit over the head of the stem nicely and firmly, as shown in Fig. 2. But often the workmen get careless, and instead of providing a key of right size, they permit the use of one of larger size than the manufacturer intended. Consequently we have a fit like that shown in Fig. 3, and in a short while the key turns on the edges of the stem and wears them off at *F* and at the other edges, and the stem cannot be revolved. This is dangerous, as it may be required to turn the stem promptly in the event of a fire, and the failure of the key socket to properly fit would cause a long delay and give the fire a headway. In other cases the writer has seen the upper portion of the hydrant provided with a platform through which is cut openings for inserting the key shaft for operating the gate of the hydrant, and in which the opening is not properly aligned with the head of the gate stem. The result is that the socket and the stem fit about as represented in Fig. 4, at *G*. This is very risky, for the reason that the key may be turned imparting the necessary revolving motion to the gate stem, and serious results may follow. The mode of fixing this consists merely in taking the proper measurements for



Some Reasons Why the Fire Protection in Gas Works is Non-Effective.

the opening for the key shaft directly over the headpiece of the gate shaft.

Leaded Joints.—Among the forms of packing the leaded joints we have the plain sheet lead, a sample of which is shown in Fig. 5, and which type of packing is very effective when properly applied and correctly cut. In the illustration is shown a piece which is not in proper condition for use, it having been spoiled in punching the hole too near the edge, in which case the pressure of the flanges of the pipes will soon cause the packing to break at that point and make a defective place like that shown. Therefore all lead packing should be examined to see if the holes are properly cut, and as to the size of the packing, this should properly conform to the size of the flanges. When the size is much under that of the flanges in diameter, the condition will be like that at I in Fig. 6, and a poorly constructed joint results, which is weak and liable to leak. On the other hand, if the packing is cut too large in diameter and the edges project and become torn, as at *J*, Fig. 7, we have equally bad results and leakage of the joint may occur. The only way to do is to cut the packing purposely for the joint and see that it properly corresponds with the diameter of the flanges of the pipe.

Plugging Leaks in Pipe.—The water service of a gas works is frequently affected by numerous leaks, for the fire service pipes are not considered, as a rule, as being of very much importance, and a few leaks are permitted to pass; but all leaks of whatever size should be plugged, and it is not wisdom to plug them with straight pins, as in Fig. 8, because these pins often work loose in a short time and permit leakage at the sides, as at Fig. 9. It is convenient to use the pin method, for the reason that the only work needed is to bore the leak out to a round hole and drive in a tapering pin; but this pin should be threaded and the hole in the pipe tapped so that the pin may be screwed into place, as shown in Fig. 10, in which case we have a firm and tight as well as a lasting plug.

Plugging with Bolts.—It is customary to plug leaks in fire service pipes with bolts in some places, after the methods shown in Figs. 11, 12 and 13. In the first figure is shown the improper mode of using a bolt. The process first consists in boring the leak out so as to permit the insertion of the bolt, then the bolt is hammered over on the inside, and the pressure of the bent end is supposed to be hard enough on the inside of the shell of the pipe to close the leak. But this frequently leaks, and so the machinist resorts to the process shown in Fig. 12, in which the inner end of the bolt is split and opened so as to afford the required pressure and stop the leak. This method is better than the first, but is not so sure as the method shown in Fig. 13, which consists in using a complete bolt and nut. The nut can be tightened up so as to close the heads of the nut on the leak and make a lasting and effective preventative.

Winding Pipes.—In Figs. 14 and 15 are presented the processes of winding water pipes for fire service in gas works with rope of manila, so as to protect from frost and the climatic conditions in general. The pipe is marked *N*, in Fig. 14, and the plan of winding the rope is shown and can be understood without detailed explanation. The rope should be freely tarred before the winding begins and then several coatings of tar should be applied when the rope is all on. The mode of winding a straight piece is shown in Fig. 15, in which *O* marks the pipe.

Liquid Air as a Means for the Manufacture of Oxygen.

By Henry Morton, Ph. D., Sc. D., LL.D., in *Stevens Institute Indicator.*

Readers of the *Indicator* may remember that, in the numbers for April and July, of 1899, beginning on pages 113 and 239, there were published two articles by the present writer in which the extravagant claims which had been brought before the public for "Liquid Air" as a source of energy were discussed and disposed of.

Since that time, until recently, those interested in the promotion of companies which propose to establish a business on the manufacture and use of liquid air as a foundation have not been prominently before the public.

Quite recently, however, extensive advertisements and circulars have brought the subject into notice along new lines.

Though the language of these is largely indefinite or ambiguous, yet it does not seem that the former fallacies have been definitely repeated, though they are in a way hinted at, but the merits of the scheme are now proclaimed in relation to a possible use of the liquid air process as a means for the production of cheap oxygen gas.

Air, as of course all know, is substantially a mixture of 4 parts of nitrogen with 1 part of oxygen, and when liquefied in the usual way this proportion is substantially maintained in the liquid. As the liquid evaporates, however, the nitrogen escapes much faster than the oxygen, and thus after a time what is left will be mainly oxygen, the nitrogen having escaped or been driven off, or, as we might say, distilled. If, then, we pass a stream of liquid air continuously into a vessel in which evaporation is allowed to take place, we will in time find said vessel to be filled with substantially pure oxygen.

If this were all, and no effort was made to utilize the cold of the evaporation of the liquid air, such a process would be very costly. Mr. Tripler's figure for the cost of liquid air, it will be remembered, was 20 cents a gallon, and five gallons of "liquid air" would be needed to produce one gallon of oxygen; or, in other words, each gallon of liquid oxygen would cost $1.

This gallon of liquid oxygen would, on expanding to atmospheric temperature and pressure, give about 104 cubic feet, or, roughly, each cubic foot of oxygen gas would cost one cent, or, 1,000 cubic feet would cost $10.

It is, of course, obvious that, by employing "regenerative processes," by means of which the cold from the escaping nitrogen, and also that from the vaporizing oxygen, was transferred to the air which was being liquefied, the cost of manufacture could be greatly reduced.

What that reduction would be there are, as yet, I believe, no data for computation, but it would without doubt be considerable; so that it would seem probable that, as compared with the chemical methods heretofore in use for the production of oxygen, this new one would be decidedly cheaper.

The question which next presents itself is what shall we do with the cheap oxygen when we get it? This question is more difficult to answer. The present uses for oxygen are very limited, being chiefly for lime lights used in theaters, and for stereopticon exhibitions and in some refined processes in metallurgy, such as the working of platinum. The amounts used for these purposes would obviously be quite inadequate to support a large business.

In view of this the "promoters" have naturally turned to the suggestion that oxygen might be used as a substitute for air in ordinary processes of combustion, as under steam boilers, in iron furnaces and the like. In this case the quantities required would be amply great; but here another difficulty presents itself. The cheap oxygen will here encounter the yet cheaper "free" atmosphere as a competitor, and in that connection the cost of storage and transportation would be prohibitory.

For example, it has been suggested that if coal burning under the boiler of a steamship was supplied with oxygen in place of air there would be a saving due to the fact that the heat carried up the funnel by the nitrogen of the air would be retained if oxygen only was fed to the fuel. This saving has been, we think incorrectly, estimated at so high a figure as 40 per cent.

The most conclusive way to test the value of such a suggestion is to reduce it to a concrete case with actually calculated proportions of parts, volumes and weights; as, for example, in one of our Atlantic steamers.

To begin with every ton of such coal as is used on our ocean steamers would require about 2½ tons of oxygen for its combustion[1], and if this was carried along like the coal supply, the cargo capacity would be fatally reduced, as regards weight, even neglecting the strong steel cylinders in which the gas would need to be stored, and which would weigh much more than the gas.

As regards bulk also, even if the oxygen gas was carried under a pressure of 2,000 pounds to the square inch, each ton of coal would require about 500 cubic feet of compressed gas, and as 2,000 tons is a fair allowance of coal to carry one of our large steamers across the Atlantic,[2] this would mean that about 1,000,000 cubic feet of *compressed* gas in cylinders would need to be loaded into such a steamer. This volume of gas alone, not allowing for any lost space between the cylinders, would be more than 10 times that of the "bunker" capacity for the 2,000 tons of coal.[3]

If the gas was not compressed then each ton of coal would require about 66,000 cubic feet of gas, or for as much coal as would carry a steamer across the Atlantic, 132,000,000 cubic feet. Now as the capacity of the huge gasholder, which is such a conspicuous object in New York city, as seen from the Hudson river, is 3,500,000 cubic feet, it follows that no less than 38 such gasholders or, if one prefers, balloons of equal capacity would need to be towed along by a steamer to furnish it with a full supply of oxygen. This, it is true, does not allow for the assumed 40 per cent. saving of fuel, and with that included *only* 22 balloons would be required.

To meet the above, it might be suggested that the oxygen should be manufactured as needed on board of the vessel. This, however, would require machinery comparable in bulk and weight with the engines driving the vessel, and, therefore, this suggestion also fails to relieve the difficulty.

Another practical difficulty, which at once suggests itself to any one fimiliar with the combustion of fuels of any sort in oxygen, is the enermous intensity of the temperature produced. A furnace fed with oxygen in place of air, would melt down or burn up in short order, not because a pound of coal would yield a greater *quantity of heat* if burned with oxygen, but because it would develop this quantity with a more intense combustion and so produce a greater and practically destructive *intensity* of temperature.

The above simple calculations show how utterly inpracticable, not to say absurd, is the suggestion that oxygen might be used with advantage in the furnace of a steamer.

We have selected the case of a steamer from those referred to by the "promoters" of the new oxygen process, as involving data easily secured; but it goes without saying that the conditions with a locomotive or any other traveling motor would be substantally the same, and that, even with stationary engines, the bulk and mass of the oxygen gas to be handled would render its cost prohibitory by reason of the first cost and operating expense of the machine required to produce and manuipulate it.

1. One pound of carbon requires 2.66 pounds oxygen for its combustion, and 1 pound of hydrogen requires 8 pounds of oxygen.
English steamer coal contains about 80 per cent. carbon and 5 per cent. hydrogen, American steamer coal, about 75 per cent. carbon and 5 per cent. hydrogen—average for both coals, say 77 per cent. carbon and 5 per cent. hydrogen.

$$\text{Oxygen for pounds of coal, } \begin{cases} \text{for carbon} & .77 \times 2.66 = 2.05 \\ \text{" hydrogen} & .05 \times 8 = .40 \end{cases}$$
$$2.45$$

or, say, 2½ pounds oxygen for combustion of each pound of coal.

2. Tons of coal required for steamer across the Atlantic. Table in London *Engineering*, 1893, Vol. I., p 469, gives, for the Umbria, 1900 tons. The estimate of coal for the Campania from the same table is 2,900 tons. The St. Louis has bunker capacity for 2,500 tons, *Engineering*, 1895.

3. Space required to store a ton of coal, Kent's Mechanical Engineer's Pocketbook, p. 170. To store ton of 2,240 pounds. Bituminous coal 41 to 45 cubic feet. Anthracite coal 34 to 41 cubic feet.

On the Determination of Carbon and Hydrogen by Combustion in Oxygen using Copper Oxide.

By Messrs. Charles F. Mabery and William R. Clymer, in *Jour. Am. Chem. Soc.*

In a former paper on combustion with copper oxide it was stated that some experiments were in progress to determine the conditions of efficiency, and limits of accuracy when applied to the analysis of oils containing only carbon and hydrogen.

In the long and tedious experience in the analysis of the great number of hydrocarbons that we have under examination in this laboratory, there have been ample opportunities to observe the working details in the hands of a large number of operators who have served at different times as assistants.

The difficulties in the way of securing results with oils containing only carbon and hydrogen, that will calculate closely to 100 per cent., are much greater than with substances containing smaller proportions of these elements, and require skill and patience on the part of the operator.

Our experience shows that copper oxide is reliable after it has been brought to a constant condition by blank trials. The gases that are involved in the combustion of some of the hydrocarbons require the highest temperature in presence of oxygen that can be brought to bear, without too great a strain on the combustion tube.

The first essential is a drying apparatus that will remove water and carbon dioxide from air and oxygen, and remain in good condition without too frequent renewal. The apparatus now in use in this laboratory, which does not need renewal oftener than once in a year or two, consists of two pieces of combustion tubing 1.75 meters long, with a bend of 30 cm. from one end, with an angle of about 105°, and placed on the wall in front of the combustion furnaces. One of these tubes for air and another for oxygen are nearly filled with broken glass and concentrated sulphuric acid. A second set of tubes are filled to the same extent with glass and a 40 per cent. solution of potassium hydroxide, one for air and another for oxygen. Air is supplied from a large iron tank under water pressure and the flow is regulated by a mercury seal. Oxygen is supplied from a smaller tank under water pressure regulated by an overflow.

For absorbing water from combustion, there is no more convenient nor efficient means than concentrated sulphuric acid. One point must be borne in mind and that is the retention of carbon dioxide by the acid. Since it is well known that concentrated sulphuric acid dissolves carbon dioxide to the extent of 75 per cent. of its volume, some experiments were made to ascertain just the condition necessary to avoid retention in analysis.

In one experiment dry carbon dioxide was passed for one hour through 2 cc. of the acid in a U-tube, just sealed by the acid. Then dry air was passed through the acid for two hours, when the tube was found to have gained 1 milligram in weight. At the end of another hour the gain was reduced to 0.0008 gram, and at the end of the third hour the weight was just the same as at the beginning of the experiment.

In a second experiment conducted in the same manner the original weight was reached in two and one-half hours. In a third experiment a larger sulphuric acid tube was used containing 7 cc. of the concentrated acid. After passing carbon dioxide for one-half hour and air for one hour and fifteen minutes the gain in weight was 0.0075. In continuing the passage of air at the rate of 500 cc. per hour for different lengths of time the following results were obtained.

15 minutes.	0.0058 increase.
15 "	0 0047 "
15 "	0.0037 "
1 hour.	0.0029 "
1 "	0.0018 "
1 "	0.0018 "
1 "	0.0001 "

It was, therefore, only after air had been passed five hours that the weight was reduced to the original. In a third experiment a potash bulb was placed in front of the sulphuric acid tube, and carbon dioxide was passed one hour, and air for one hour. The potash bulb was now attached and the gain in weight (with air) compared with the loss in the acid tube.

Hour.	Loss in Acid Tube.	Gain in Potash Tube.
1	0 0014	0 0014
1	0 0008	0.0007
1	0.0005	0 0005
1	0.0002	0.0002
1	0.0000	0.0001

In a fourth experiment, carbon dioxide was passed for one hour through 2 cc. of acid, then air for one hour, then air for one hour more and weighed; the gain in weight was 0.0007 gram. Carbon dioxide was then passed for one hour and air for another hour, then at the end of a second hour the weight was 0.0004 gram. In three repetitions the gains were respectively 0.0006, 0 0004, and 0.0006 gram, showing that passing air the same length of time leaves the same weight of carbon dioxide in the acid. These experiments indicate that when a small volume of acid, 2 to 3 cc., is used with the large volume of oxygen and air used to expel carbon dioxide from the tube, very little of the gas remains dissolved in the acid. But with larger volumes of the acid there is danger of retention of carbon dioxide.

In testing the capacity of sulphuric acid to retain moisture, moist air was passed through 2 to 3 cc. of the acid at the rate of 1100 cc. per hour for four hours. At this rate the bubbles cannot be counted. In front of the sulphuric acid tube was placed a high tube filled with phos phorus pentoxide but there was no gain in the latter tube. There is therefore no danger of loss in water if sulphuric acid is used. The only value of this experiment was to ascertain the conditions since Morley showed several years ago that sulpuric acid is a most efficient drying agent. The form of sulphuric acid tube we have used for several years has a bulb for collecting the greater part of the condensed water which is poured out after weighing. The forward bend of the U is 10 cm. in height from the bottom and a side tube is attached for connection to the potash bulb. When containing 3 cc. of concentrated acid, and 0.2000 gram water is weighed in each combustion, the tube may be safely used without replacing the acid in ten or twelve combustions and probably longer. That sulphuric acid is preferable to calcium chloride has frequently been shown, since the best fused calcium chlo ride may contain basic chloride which retains carbon dioxide. It was shown by Winkler that lime in the chloride cannot be completely saturated by carbon dioxide, since the inside of the granules remain caustic for a long time.

It is doubtful whether there is a more convenient apparatus than the Geissler potash bulb for the absorption of carbon dioxide, especially if the substance analyzed consists, for the most part, of carbon and hydrogen. There is no danger of loss of carbon dioxide if the solution of 33⅓ per cent. potash be not used in more than four or five analyses. But there is danger of loss of moisture from the potash bulb unless care is taken to prevent it.

Some experiments were made to ascertain the conditions of safety. In one experiment the calcium chloride tube in front of the potash bulb was filled with freshly fused calcium chloride, broken to the size of grains of rice. Air was passed through at the rate of 550 cc. per hour with no loss in weight of the potash bulb, and the result was verified by placing a sulphuric acid tube in front of the calcium chloride tube which showed no gain in weight. Any faster rate than this showed a loss in the potash bulb and a corresponding gain in the sulphuric acid tube. On replacing the granular calcium chloride with other more finely ground, in a slightly longer tube, and passing air at the rate of 1050 cc. an hour, or 120 bubbles a minute, there was no change in weights. With a calcium tube of common length, 6 cm., a rate of 880 cc. per hour caused a loss of 0.0004 gram in the potash bulb and a gain of 0.0005 gram in the sulphuric acid tube. It is therefore safe to pass 500 cc. per minute through a tube filled with freshly fused finely granular calcium chloride. Such calcium chloride may be used in a considerable number of analyses. This rate can not be exceeded in the combustion of oils that are in part or all volatile without decomposition, or that yield gaseous products in burning. But this rate is in any sense in excess of the rate of evolution of gas from the combustion, since the carbon dioxide is, for the most part, immediately absorbed as soon as it meets the potash solution. By replacing the fused calcium chloride with phosphorus pentoxide, there is no loss even when the rate exceeds 1000 cc. per hour, or 120 bubbles a second. But the oxide offers no advantages over the fused chloride in ordinary analysis.

In preparing for a long series of combustions a combustion tube should be selected that promises to stand 50 to 100 analyses, since it requires a long time to get the tube and its contents and connections in good working order. A long time is required to remove all the volatile impurities from the best copper oxide, and the moisture from the tube and oxide. Rubber stoppers are the only means for satisfactory connections, but before they become constant in weight probably some of the sulphur must be volatilized and moisture expelled. It is therefore necessary to test carefully all parts of the apparatus by means of blank experiments in the beginning, and even after the apparatus becomes constant it is well occasionally to apply a blank test.

In conducting analysis of such bodies as the high-boiling constituents of petroleum, the closest attention to details is necessary. The tube must be as hot as it will stand, and yet not hot enough to lessen its durability, on account of the labor involved in getting it in good condition. If the combustion tube be filled with oxygen before the substance is inserted and the rate of volatilization be carefully controlled, any hydrocarbon may be burned in a furnace with 20 burners. Many analyses were lost before these conditions were fully understood. In view of the possibility that a longer combustion tube might insure complete combustion and shorten the time of the analysis, two furnaces were placed together, and a tube nearly two meters in length was used. But the results were not more satisfactory than with a tube of ordinary length.

As a general summary of what is necessary to insure desirable accuracy in such determinations, it must be fully understood at the outset that no operation in analytical chemistry demands greater precautions, closer attention to details, or more skill and patience on the part of the operator to insure results within 0.20 per cent. of the maximum 100 per cent. in substances composed solely of carbon and hydrogen, such as petroleum oils.

In view of the great amount of work that will have to be done in determining the constitution of the large number of hydrocarbons with high molecular weights in Pennsylvania, California, and other petroleums, it would be a great advantage if a method for the determination of carbon and hydrogen could be devised that would avoid the tedious routine of the present method. But with present knowledge of this subject this method is probably all that can be hoped for. The Geissler potash bulb and the sulphuric acid tube seem to be as convenient forms as can be devised and they are capable, as shown above, of retaining carbon dioxide and water with as rapid delivery as is consistant with complete combustion. Rubber corks are objectionable, but they are the only convenient and reliable means of connection available.

We have tried successfully weighing the bulbs full of oxygen, thus avoiding the expulsion of oxygen by air. But since the time necessary to carry forward all the carbon dioxide is equivalent to that necessary to displace oxygen by air, there is nothing gained by weighing the bulbs filled with oxygen. The precautions necessary to insure cleanliness of the bulbs and constant conditions of moisture and temperature in weighing must be carefully observed.

[From the *Journal of Gas Lighting.*]

The Presence of Naphthaline in Coal Gas: A Novel Theory.

[Abstract of a paper read by MR. R. W. ALLEN, M. A., before the London (Eng.) Section of the Society of Chemical Industry.]

In commencing his paper, Mr. Allen said the discussion as to the amount of naphthaline ordinarily present in coal gas, and the prevention of its deposition therefrom, having been somewhat revived of late, he thought the result of some experiments made by him in the laboratory of University College, Auckland, New Zealand, about 18 months ago, might perhaps be of some interest. The most plausible explanation of the deposition of naphthaline in gas pipes was based on the supposed saturation of the gas, and the consequent supersaturation when the temperature fell, and deposition of some of the naphthaline. In order to ascertain whether this was really the case, he first determined the amount of naphthaline required to saturate a given volume of such gases as air, hydrogen, and carbon dioxide, which might be designated

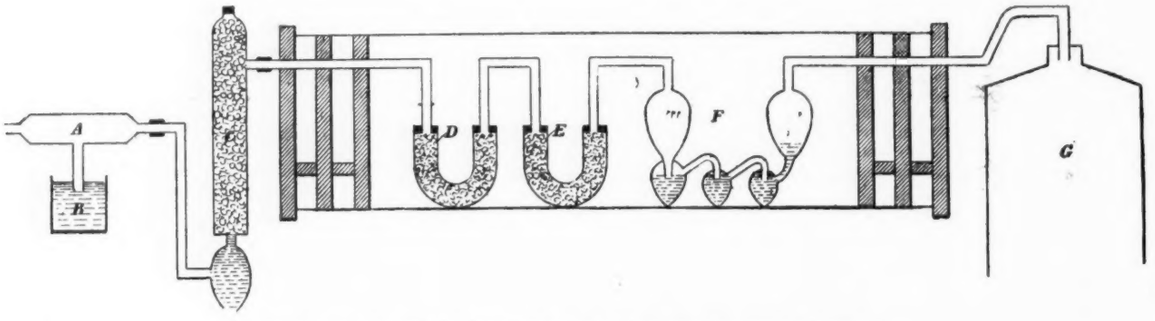
as "indifferent" gases, and then ascertained the amount of naphthaline required to saturate the same volume of coal gas carefully purified from any naphthaline that it might already contain. In this manner one might ascertain whether the coal gas really differed from an indifferent gas, at the same temperature, as to the amount of naphthaline required to saturate it. If there was a difference, and if it was due to the presence of the lighter hydrocarbon vapors in the coal gas, then he thought the pressure of the vapors of such powerful solvents of naphthaline as ether, carbon bisulphide, benzene, chloroform, and ethyl alcohol in air ought to emphasize the difference. If any difference could be detected, then comparing the amounts of naphthaline required to saturate equal volumes of air and coal gas at the same temperatures, the exact amount of that substance in the gas could be ascertained.

By two totally different methods, the author determined the amount of naphthaline, in grains, required to saturate 100 cubic feet of air, hydrogen, and carbon dioxide at temperatures varying fronm 32° to 212° F. The methods employed were: The direct evaporation method, wherein a known volume of each gas was passed through U-tubes containing dry powdered naphthaline, and the amount of naphthaline carried over estimated by the loss of weight of the U tubes. Secondly, by the determination of the vapor pressure by the barometrical method. The author, referring to a blackboard sketch of the apparatus employed in carrying out the experiments under the first method, said the gas—hydrogen, carbon dioxide, or air—was passed in through the pressure gauge *A*, which was charged with oil *B* in place of mercury, because oil, on account of its lower specific gravity, showed slight changes of pressure very much better. It was then passed through a tower *C* filled with pumice saturated with sulphuric acid. Then it was passed on to a zinc water bath about 3 feet 6 inches by 2 feet 6 inches long, and 2 feet broad, comprising a number of compartments designed to prevent any air currents passing into the apparatus. The gas, already partially dried, passed over into a drying tube packed with calcium chloride *D*. A sulphuric acid bulb *F*, following the naphthaline tube *E*, was inserted to absorb the bulk of the naphthaline carried over at the higher temperatures, so that it might not clog up the exit pipes. From the sulphuric acid bulb the gas passed into the aspirator *G*. The volume in the aspirator being carefully determined, and the temperature—viz., that of the air—and the pressure being known, the corrected volume of the gas in the aspirator represented the volume that had passed over the naphthaline. By weighing the naphthaline tube before and after the experiments, the amount of naphthaline carried over was easily found.

The duration of the experiments varied very greatly. The shortest ones lasted only 1¼ hours. Those were with hydrogen. The longest ones were 135 hours; and they were with air. The volume of gas passed over was only 1.27 cubic feet; so that the rate, even in the fastest experiment, was only 1 cubic foot per hour. A rather remarkable agreement might be observed between the various values. The rate at which the hydrogen seemed to saturate itself was exactly the same as that at which the much heavier air or coal gas saturated itself, and at corresponding times the weights carried over were practically identical. The difference between experiments of 1¼ hours' and 135 hours' duration amounted to only (in that particular case the temperature was over 86° F.) 7 per cent. The close approximation of the values at (say) 24 hours and 110 hours, showed that the gas at 24 hours was practically saturated.

The foregoing, the author said, was briefly the method employed for determining directly the amount of naphthaline that was required to saturate 1.27 cubic feet of gas; and Table II. contained the results (calculated, and checked from curves) as to the amount of naphthaline required to saturate 100 cubic feet of gas at temperatures varying between 32° and 212° F. The author here called special attention to the close correspondence there was between the weight of naphthaline required to saturate 100 cubic feet of gas at 59° F.—viz., 19 grains—and the weight extracted by Dr. Bueb by his washing process from the same volume of coal gas—viz., 20 grains, at a temperature of 60° F.

The author next determined the amount of naphthaline required to saturate the same volume of coal gas, carefully freed from any trace of naphthaline, at the same temperatures; and he obtained results identical with those for the indifferent gases. Hence it would appear, he said, that the vapors of the heavier hydrocarbons present in coal gas exerted no influence on the power of the gas for saturating itself with naphthaline. To confirm this, experiments were made with air containing the most powerful solvents of naphthaline—viz., ether, carbon bisulphide, benzene, chloroform, and ethyl alcohol. Quoting from a table giving the values, at 140° F., obtained from various gases, he said that 1.27 cubic feet of air, at 140° F., carried over 537 grains, the same volume of hydrogen 537 grains, of coal gas 538 grains, of acetyleue 538 grains, of marsh gas 536 grains; of air saturated, at 60° F., with the following vapors—viz., of ether 548 grains, of carbon bisulphide 537 grains, of chloroform 542 grains, of benzene 547 grains, of ethyl alcohol 549 grains. From this it would appear that the presence of solvent vapors in quantities insufficient to saturate the gas exerted no influence on the amount of naphthaline vapor the gas could hold



Drawn from the Rough Blackboard Sketch of the Experimental Apparatus Employed.

TABLE I.

Temperature 86° *F. Volume of Gas Employed* = 1.27 *cubic feet.*

Gas Employed.	Length of Experiments. Hours.	Weight of Naphthaline Carried Over. Grain.
Air.	2½	.4907
"	3½	.4923
"	4	.4938
"	7	.4969
"	9½	.5000
"	11	.5047
"	17	.5092
"	30	.5123
"	39	.5170
"	135	.5293
Hydrogen	1¼	.4815
"	4½	.4830
"	6¼	.4861
"	14	.5092
"	24	.5200
"	110	.5278
Coal gas	3	.4861
"	6	.4938
"	15	.4969
"	20	.5015
"	55	.5231

TABLE II.

Temp. Degrees Fahr.	Weight in Grains of Naphthaline Saturating 100 c. ft. of Gas.	Temp. Degrees Fahr.	Weight in Grains of Naphthaline Saturating 100 c. ft. of Gas.
32	6.0	131	317.0
41	9.8	140	482.0
50	14 1	149	723.0
59	19.0	158	1050.0
68	24.6	167	1430.0
77	30 9	176	1898.0
86	39.5	185	2426.0
95	57.5	194	3035.0
104	83.5	203	3727.0
113	132.0	212	4420.0
122	208.0		

in diffusion. The gas was next saturated at the temperature of 140° with the vapors of benzene and petroleum oils. So great was the increase in the amount of naphthaline carried over that the cooler parts of the apparatus almost immediately blocked up, the naphthaline in the U tube completely liquefied, and the experiment stopped. Having thus established the fact that the coal gas could not, unless saturated with solvent vapor, hold in diffusion more than the same volume of naphthaline, and having found the gas employed was not saturated with benzene or petroleum vapors, it was clear that the amount of naphthaline present in the gas could be determined by observing how much additional naphthaline was required to saturate it. To diminish the errors as far as possible, the amount of naphthaline required to saturate the same volumes of gas from which all traces of naphthaline had been first removed, was also simultaneously determined.

The temperature of the experiment was 130° F.; and a sample of ordinary coal gas was used, carefully dried in calcium chloride tubes. The sulphuric acid tower was removed when using coal gas, so that the sulphuric acid should not act on the hydrocarbons, and remove them from the gas. The weight carried over by 1.27 cubic feet, the temperature being 130° F., was 153 grains. When the gas had been carefully purified from all naphthaline by passage through tubes immersed in freezing mixtures, the weight carried over was 152 grains. When the gas was not only passed through the freezing mixtures, but through the drying tower, and then through two bulbs of sulphuric acid at the temperature of the bath, the weight carried over was still 152 grains. From this it would appear that the coal gas which was supposed to be very nearly saturated with naphthaline, and which actually did form bad deposits, in reality contained none of the vapor of that body. This was confirmed by a long series of experiments. A little air saturated with naphthaline at the atmospheric temperature, by passage through a U tube in a freezing mixture of ice and salt, deposited out practically the whole of the naphthaline at this temperature. In this way the small quantity of naphthaline could be detected. A considerable volume of coal gas was next similarly treated; but no trace of naphthaline was to be seen in the U tube—only benzene and oily substances. This he took at the time to be conclusive proof that the gas itself contained no naphthaline. In truth, it did not clear up this; it only showed the possible amount of naphthaline was very small.

Subsequently Professor Brown experimented with large volumes of gas on the gas works; but whether he did this before it entered the mains, or shortly after, he (Mr. Allen) was unable to say. At all events, he was unable to detect anything but a limited trace of naphthaline present; and yet the trouble from deposits was very great indeed. The truth of these observations had since been confirmed by passing the coal gas through a series of U tubes, immersed in the freezing mixture of ice and salt, treating the frozen out product with a mixture of nitric and acetic acids, evaporating off any excess of acid and much of the nitro benzene that was formed simultaneously with any nitro naphthaline, and converting any naphthaline present into nitrophthalic acid by means of an oxidizing mixture of potassium bichromate and sulphuric acid. No naphthaline could thus be found, although a small amout of the vapor of that body if introduced into the gas could be readily detected in this way. The experiments extended over a period of 10 months, during which time the coal gas, proved to be free from naphthaline as it left the pipes, was continually forming deposits in the services. It would thus appear that they had this anomaly—that coal gas free from naphthaline would form deposits of that body in its passage through the pipes. The only possible explanation seemed to be that, under certain conditions, naphthaline was formed in the pipes themselves, and continued to deposit itself there. That this was always the case when naphthaline deposits were formed, the author did not wish to assert. However, it would satisfactorily account for the formation of deposits from gas containing less naphthaline than was sufficient to saturate it at any such temperature as it was likely to be subjected to in the pipes. The usual explanation "fall of temperature" would hardly suffice; for an ordinary sample of gas saturated with naphthaline at 60° would form no deposit of the solid if cooled to 50°. He had repeatedly tried this, and had found that, even on cooling the gas to—20° F., no deposits were formed.

The question arose as to the way in which this was brought about. Was there some unstable substance present in the gas, or formed under certain conditions in the pipes, which, under new conditions, spontaneously decomposed or combined with the hydrocarbons to form naphthaline? This question he was unable at present to answer definitely. His belief was that such an unstable body was already present in the gas, or was formed by the gas as it traversed the mains, and, under suitable conditions, combined with the hydrocarbons in the gas to form naphthaline.

In summarizing his conclusions, the author called attention to these points: (1) The very small amount of naphthaline required to saturate a given volume of gas at ordinary temperatures. (2) The fact that the presence of benzene or hydrocarbon vapors in quantities insufficient to saturate the gas did not affect the amount of naphthaline that a given volume of gas could hold in diffusion. (3) The easy detection of naphthaline by the formation of nitro-phthalic acid. (4) That gas which contained little or no naphthaline as it left the gasholders would, under certain conditions, form deposits in the distribution pipes. (5) Consequently, the necessity arose of looking elsewhere than to changes of temperature for an explanation of the formation of deposits.

Discussion.

Dr. F. Clowes, called upon by the Chairman, said he was glad he had been asked to say a few words, because he was responsible in the first place for the paper being brought before the Section; he was the first to suggest to the Committee that Mr. Allen should be allowed to bring it before them. He must say that it was a paper of a somewhat startling character. Gentlemen present would feel that in some sense a mine had been sprung among them. They had all held—and perhaps they could hardly give any reason for holding—that naphthaline was carried over by coal gas in larger quantity than it would be by any of the simple gases. Now Mr. Allen had given them figures which he (Dr. Clowes) thought incontestably proved that their notions on the subject had little foundation in fact. He could not see how they could get out of the conclusion that air and hydrogen carried over the vapor of naphthaline at least to the same extent as coal gas itself; and Mr. Allen had supported the experiments made by one method by experiments made by another. He (Dr. Clowes) might say that this work had been carried out by a young chemist of the greatest care and integrity; and those present who remembered Professor F. D. Brown's work when he was in England would know that any work done in his laboratory, even if not conducted by the Professor himself, would be certain to be performed with the greatest possible carefulness of manipulation. He knew that Professor Brown had had oversight of this work, and had in some sense mixed himself up with it; and work with which he had identified himself was work about which they could not question the scientific accuracy. Mr. Allen had certainly gone against all their prepossessions on this question. In regard to the latter part of the paper, they were assured that in some experiments on coal gas naphthaline had not been present, or its presence had never been detected in any quantity, but that from the gas naphthaline had been afterwards deposited. Here they had a "facer;" and he did not know what to say about it. He had made no experiments; but he could not doubt the experiments which Mr. Allen had brought before them. He thought some of the gentlemen present would be itching to repeat Mr. Allen's work; and repeating it with equal care, they would possibly find that they arrived at similar conclusions. But he (Dr. Clowes) could not help feeling that Mr. Allen had shown, as far as his work had gone, that naphthaline must, under certain conditions, be formed in gas in which it did not pre-exist. He himself had only had limited experience; and he should like to know what those conditions were. It would be interesting to learn what were the substances from which the naphthaline had been formed (they must assume) by chemical condensation. He sincerely hoped that Mr. Allen, who had shown himself to be an adept experimentalist, would be induced, by the reception of the paper that night, to continue his experimental work. Mr. Allen could not feel that he had finished his work; and if they could induce him to continue it, and bring the subject as to the formation of the naphthaline again before the Society, he (Dr. Clowes) would feel that what he did in recommending the paper to the consideration of the Committee had not been thrown away. There was food for contemplation of the most varied character in the paper.

Mr. T. S. Lacey (of the Pimlico station of the Gas Light and Coke Company) said it seemed to him that the chief interest in the paper to gas manufacturers was that it appeared, so far as he could see, to give them a method of estimating the amount of naphthaline in coal gas. The question of naphthaline deposits was, as they all knew, a very difficult one; and the first thing they required, before they could form any opinion as to the causes of the deposits, was that they should be able to measure the amount of naphthaline in the gas. It was certainly more important for them to be able to estimate these substances before forming an opinion as to the causes of the deposits than to simply make a guess as to what was going on. There was one circumstance that differed slightly from these experiments, and that was the presence

of water vapor. He did not know, but he thought it quite possible that the effect of water vapor on the gas might considerably alter its behavior in relation to the deposition of naphthaline. He fancied these experiments had all been made with dry gas. They did know this, that, when gas was passed through a wet meter containing a large quantity of water, it very frequently occurred that deposits of naphthaline were found immediately after the gas had passed through that vessel. This certainly would go to show that saturation of the gases with water vapor had some effect in causing a very rapid deposit of the naphthaline. From this, one might be inclined to judge that the experiments made on dry gas might not be a direct guide to what might occur with a gas containing water vapor. However, another method had been shown them for estimating naphthaline. Possibly others might pursue these investigations; and then they would be able to arrive at, if not the solution of the problem, some information that would possibly set them on the right path.

Mr. J. W. Helps (Croydon) said it was difficult to discuss a somewhat scientific paper such as the one Mr. Allen had submitted without having first had the opportunity of reading it; and therefore the remarks he had to make would only be on general principles. As Dr. Clowes had observed, Mr. Allen had given them a "facer." The theory which he had brought before them was one which he (Mr. Helps) must say did not coincide with the general ideas of gas engineers, nor did it coincide with the facts that their experience from day to day presented to them. They had been brought up in the idea that coal gas, being exposed throughout the works to deposits of naphthaline, left the works saturated. He was inclined to believe with Mr. William Young, who had done a great deal in investigating this matter, that the gas was saturated at the particular temperature at which it left the works. He should like to ask Mr. Allen one or two questions, and to inquire how his theory would coincide with two or three conditions and facts which he (Mr. Helps) had noticed in his own experience. He would take, for instance, the case of gas, say, at a temperature of 50° or 60° as it went into the holders on a hot summer's day—saturated with naphthaline at that particular temperature. In the holders, it was exposed to the hot sun; and the temperature was considerably raised. He was speaking now of a works where naphthaline was generally found both on the works and in the district; and the gas left the works at a higher temperature than it went into the holders. He found on that hot day that the naphthaline deposits were very much greater in the district than in the winter. If the gas did not pick up naphthaline at that particularly high temperature and drop it in the town afterwards, he should like to know where the naphthaline came from. He should like to mention another case. In two works almost side by side, and working under almost absolutely similar conditions (he referred to his own works at Croydon, which were very near those managed by his brother), the same coal was used, the same conditions of carbonization, and, with one exception, the same treatment after carbonization; and, notwithstanding. in his brother's town, naphthaline had never yet been seen, while in his own it was seen far too frequently. If this condition of affairs existed in the mains, and naphthaline was, as was assumed, synthetically built up in the mains, how was it that it was not built up in the town which he mentioned, while it was at Croydon? He agreed with Mr. Lacey, that, if Mr. Allen had not done anything else, he had shown them a method whereby they would be able to estimate the amount of naphthaline in coal gas; and until they could do this, they were working in the dark. Naphthaline was generally known as the gas managers' bugbear; and if Mr. Allen or some other chemist could only find out a means of ridding them of it, he would earn the thanks of the gas industry and profit himself. Gas managers had allowed this subject to slide in the most absurd way; and they were indebted to chemists for looking into the question for them. They did hope that Mr. Allen and others who might follow would go carefully into the matter, and give the gas industry the benefit of their researches, and try to rid gas managers of this bugbear which troubled them day and night, summer and winter.

Mr. Watson Smith (London) asked whether Mr. Allen had made an examination, under the conditions described, in connection with gas as it was produced, and also of the coal tar deposited previous to obtaining the gas. In several cases he (Mr. Watson Smith) had examined both; and he had been perfectly conversant with the condition of the gas. When the gas had been highly charged with naphthaline, he had always found the coal tar deposited—that was, previous to the gas entering the mains—had also been rich in naphthaline too. He also happened to know that gas manufacturers who used Wigan cannel coal, if they dared to use it exclusively, would obtain a gas which was free of naphthaline and would give little or no trouble, and the coal tar also would free from naphthaline, but that the tar would contain anthracene in such a condition that it would be of no use to the alizarine manufacturer. They had therefore to manipulate their coal mixtures. There was no doubt some relation between the character of the coal and the products subsequently produced in the tar and the gas.

Mr. Helps asked to be allowed to offer a slight explanation. In comparing the two works, he stated that the mode of treatment after carbonization was similar in either case. He should have said that, in the one where no naphthaline was found, the gas and tar passed away together; and this would make it appear that the naphthaline which existed in the gas was washed out by the tar, and so did not appear in the district.

Mr. Watson Smith said he should also like to know how the author managed to completely free his coal gas from naphthaline without the benzene vapors being also removed. He understood that Mr. Allen took a quantity of coal gas and completely freed it from naphthaline. How was that done without the benzene vapors being removed? If the benzene vapors were absent, he should not consider it a proper coal gas. It would scarcely be of an illuminating character.

Mr. W. J. A. Butterfield said he had little to add to what Mr. Lacey and Mr. Helps had said. He was very interested and gratified to see that Mr. Allen had shown experimentally that the quantity of naphthaline taken up by all gases—at least, by air, hydrogen, and coal gas, was identical, as he thought statements had been very common to the effect that coal gas in containing large quantities of vapors of other hydrocarbons, could not therefore retain naphthaline to the saturating limit. One point he was not quite clear about, and perhaps Mr. Allen could give him some information. It was as to the point in the distributing system, or on the works, from which he took the gas in which he found there was no naphthaline. He noticed that Mr. Allen stated, in support of his figures as to the amount of naphthaline that gas could retain at various temperatures, that whereas he had found 19 grains per 100 cubic feet, at 59° F., Dr. Bueb had, by the washing process, actually removed practically the same amount—20 grains he (Mr. Butterfield) thought it was—from coal gas on the works. He believed that the point where Dr. Bueb was working was immediately after the condensers; but he was not quite sure it was not after the scrubbers. It seemed to prove at any rate that at this point the coal gas was saturated with naphthaline, or something like saturated, at that temperature. Had Mr. Allen any idea where the naphthaline got out of the gas when he found it at some other point free from naphthaline? It seemed to him that getting a liquid condensation product from the gas by freezing, and saying that because it was free from naphthaline, the gas could not deposit it, would not apply to gas as it was distributed. To say that thereafter the gas could contain no naphthaline, and that therefore no deposition could take place in the mains, was going too far, because although, in the first instance, they got a liquid condensation product in which the naphthaline, if it was there at all, was dissolved, after a time they had gases passing over that were not fully saturated with the liquid hydrocarbons which had been deposited, and this gas carried off the condensed liquid, and, if it was already saturated with naphthaline, it left the naphthaline which had been dissolved in that liquid behind. Under different conditions of manufacture, it was quite conceivable that gas at one time was more nearly saturated with readily condensable liquid hydrocarbons such as benzene, and that at other times it was far more nearly saturated with naphthaline, and not so nearly saturated with liquids. Under these conditions, he thought it conceivable that the naphthaline might be left behind in certain parts of the mains where there was no liquid deposit at the same time to carry it into the syphons. One interesting point in regard to naphthaline in gas supplies was that he had heard it asserted that naphthaline deposits in mains considerably diminished the illuminating power of the gas. It was inconceivable that the small amount of naphthaline in the gas would make much difference to the illuminating power whether it were retained in it or not. At 59° F., if the gas was saturated with naphthaline, it would probably make a difference of 0.15 candle. Well, if the gas passed through mains containing a deposit of naphthaline, one would expect it to arrive at the burner saturated with naphthaline; but, on the other hand, gas engineers would tell them that gas which had passed through services containing a deposit of naphthaline had its illuminating power reduced by its passage through them. This was conceivable on the assumption that the naphthaline exerted a scrubbing action on the gas, and scrubbed from it some of the hydrocarbons that were readily condensed as liquids—such as benzene—and thus reduced the illuminating power. He might say that he attempted only that afternoon, on seeing the subject of the paper, to ascertain what the effect on ordinary London gas

would be of passing it over naphthaline, and thus making sure that it was saturated with it; his object being to see whether there was any definite scrubbing action, or whether the gas had its illuminating power increased by taking up naphthaline. He was working on the ordinary gas supply to his office; and he was sorry to say the Gas Company for some reason (he was working for about three hours) varied the illuminating power of the gas by 1¼ candles. This upset all his comparisons. The illuminating power varied when the gas was not passing through any material. He was passing the gas through naphthaline, intending to observe if the illuminating power was affected thereby; then omitting the naphthaline tube, and passing the gas through a tube packed with sawdust to see whether there was any scrubbing effect due simply to passage through finely divided material. But the variation in the illuminating power of the gas at the time quite upset his experiments. But he might say that he thought it just possible there was a slight increase due to the naphthaline; and certainly the sawdust caused no increase, but perhaps a slight decrease. The experiments, however, were quite inconclusive, and needed to be resumed under more favorable conditions.

Dr. Otto Hehner said that, while listening to Mr. Allen's paper and to the experiments on which Dr. Clowes had passed such high encomiums, it seemed to him there was little connection between the author's careful experiments showing the saturation of gas by naphthaline at different temperatures and the fact that naphthaline was deposited in pipes from gas in which there was originally no naphthaline. He should have thought this curious point required some judicial inquiry; but he could not see that there had been any efforts in that direction to ascertain whether any naphthaline really was deposited. He assumed that it was on hearsay evidence that the author made the statement that pipes were blocked up with naphthaline from gas which had not contained any, as all the time he was busy in his laboratory carrying out investigations intrinsically and scientifically interesting, but which were not altogether conformable with ordinary practice. Not a scintilla of evidence had been brought before the Society to show that the gas did deposit naphthaline while it contained none. The question as to the solubility of naphthaline had received the most able attention of Mr. Allen; but regarding what actually took place in gas pipes underground they knew nothing. Mr. Allen had constructed a theory which, if ingenious, did require a little proof; and he (Dr. Hehner) had very grave doubts about it. Again, he did not think there was anything very astonishing that naphthaline dissolved in air, hydrogen, and coal gas in the same ratio. He endorsed what had been said as to the high manipulative skill which Mr. Allen had shown in his experiments; and he admitted that he had brought before them a very simple and pretty means of ascertaining whether there was naphthaline in gas. But another method of determining naphthaline in coal gas had quite lately been brought before another section of the Society by Dr. Colman; and it seemed to him, with great respect to Mr. Allen, that it was a better idea to make a definite compound of the naphthaline direct with picric acid, and then determine it, than to arbitrarily freeze the volatile substances, and then determine it. Whether a short passing of gas saturated with substances like naphthaline through a freezing mixture was sufficient to deposit it all, might be open to some doubt Probably, however, Mr. Allen had given attention to this point. When one made experiments of this kind, dealing with extremely small quantities, a very precise method of determination was required. In 100 cubic feet of gas, at 32° F., the author showed there were 6 grains of naphthaline; so that, when he worked with 1 cubic foot—and that took a precious long time—he would only get, at 32°, $\frac{1}{100}$ of the 6 grains (which was a small quantity to weigh with precision). However, he valued the experiments of Mr. Allen, and he appreciated the great care and accuracy he had bestowed upon his work; but he (Dr. Hehner) did think he had hardly given sufficient foundation for the revolutionary theory he had propounded.

Mr. R. Forbes Carpenter pointed out that Mr. J. P. Leather, of Burnley, had had some experience of washing gas with oil for the removal of naphthaline; and if anyone could contribute any real knowledge as to what Mr. Leather had done, it would be interesting. He should like to know whether since Mr. Leather had had his method in use, he had experienced deposits in any new main? Mr. Helps had indicated how in summer time, and not only in winter, gas managers were troubled with naphthaline. He himself had also been told by gas managers that the trouble occurred not only in winter but in summer; and he could quite understand how, with a change in the temperature, a previous deposit of naphthaline might be moved, so as to choke up some local service.

Mr. H. Leicester Greville said it was universally known that naphthaline was a special bugbear to gas companies. It had a peculiar tendency to accumulate in bends and angles of pipes—a fact probably largely due to friction. He believed that moisture had much influence on the formation of naphthaline deposits. With regard to the paper, it would require much corroboration before it could be accepted as a fact that gas normally left the works free from naphthaline vapor, considering that the presence of naphthaline in quantity was so evident at all points of the manufacture. That naphthaline—a substance always regarded as essentially a product of high temperature—could be absolutely produced in the gas at the ordinary temperature of the air would also require a large amount of confirmation. If naphthaline could possibly be permanently retained in the gas, instead of being deposited, it would be a great boon to gas companies, on the ground of its great value as an illuminant.

Mr. Allen, replying on the discussion, said he had dealt with his subject purely from the point of view of the scientist; his practical knowledge was absolutely *nil*. For the statement he made as to the deposition of naphthaline in gas mains, he had the authority of his own Professor (who was the Chairman of Directors of the local Gas Company), and also that of the Chief Engineer of the works, who was continually at the University (Auckland, N. Z.) where he (Mr. Allen) performed the work. He should also like to point out that the work extended over a year; and this to a great extent eliminated any variations that might have otherwise existed in the amounts of naphthaline in the gas if he had only worked at the subject a few times, and with widely differing intervals, instead of working at it continuously for nearly ten months. Reference had been made to Mr. Leather; and he (Mr. Allen) was very nearly quoting him in support of some of his statements. In the *Journal of Gas Lighting* for Sept. 26 last, there was a reference to Mr. Leather's experience, which showed that, with gas containing an amount of naphthaline utterly insufficient to saturate it, he had trouble from deposits in the mains. In reply to Mr. Watson Smith's question, as to how he prevented the benzene being removed from the gas along with the naphthaline, he made no effort to prevent the benzene being removed. He wished it removed in fact; but, on the other hand, he experimented afterwards with gas from which the naphthaline had been carefully removed and carefully dried, and the benzene was reintroduced, but in quantity insufficient to saturate it at the temperature of the bath. Dr. Hehner asked why he did not convert the naphthaline into a picrate. He did not convert it into a picrate of naphthaline because the benzene at the same time would have been converted into a picrate, and would have formed a solid; whereas, by first converting it into nitro benzene and nitro-naphthaline, and then oxidizing it with chromic acid, nitro-phthalic acid was alone formed. There was certainly no such compound of benzene formed. He therefore thought that it was much better to form nitro-phthalic acid and effectively get rid of the benzene. Dr. Hehner also remarked upon the fact that he had worked on small quantities of air. He did; but he (Mr. Allen) had the utmost confidence that his weighings were correct in every instance to (say) the 50th of a milligramme. Dr. Hehner also had no doubt that the weight of naphthaline required to saturate hydrogen, coal gas, carbon dioxide, etc., was exactly the same. Without wishing to disparage his opinion, he (Mr. Allen) might say that Professor Brown had very grave doubts whether coal gas or carbonic acid would load itself up with naphthaline at the same rate as the lighter hydrogen would load itself up. With regard to Mr. Help's question, he was sorry he could throw no light upon it, as he (Mr. Allen) was not a practical man. But it seemed to him that Mr. Help's statement that a hot summer's day had some effect on the gas, rather supported his own view. A hot summer's day was just the day when the benzene was not going to condense out—when it was not going to prevent the deposition of naphthaline at all by solution. But still, as he had said, he bowed to their opinion, being himself utterly unpractical and scientific only. Reference had also been made to the way abrupt bends seemed to facilitate the deposition of naphthaline. He had tried to imitate this in a great number of ways; but he did not succeed at all. He had electrified the gas, treating it with high alternating currents, but could not imitate the deposition in any way.

The American Gas Light Association and the International Gas Industry Congress.

The following circular matter, issued by the officers of the American Gas Light Association, shows the steps so far taken by the Association in reference to its participation in the proposed congress of the gas industry at the Paris Exposition.

NEW YORK, April 24, 1900.

To the Members of the American Gas Light Association:

The officers of the Association have received from the Commission of Organization of the International Congress of the Gas Industry, the meetings of which are to be held in Paris, in September, 1900, circulars containing the regulations governing the participation in and the conduct of the proceedings of the Congress, and a complete list of the

subjects open to consideration during the sessions. It is probable that you have also received copies of these circulars, but it has been thought well to enclose translations of them with the object of again bringing the matter before you mind.

It is important that your Council should have some knowledge as to which and how many of the members of the Association expect to attend the meetings and take part in the proceedings of this Congress. Will you therefore kindly fill out and mail the enclosed postal card promply enough to have it reach the Secretary before May 10th? The result of this inquiry can then be laid before the Council at its meeting of May 15th, and thus enable it to be in a position to appoint as official representatives of the Association those members who expect to attend the meetings, and also to inform the Commission of Organization of the part that will be taken by these representatives in the preparation and discussion of papers on the various subjects proposed for consideration by the Congress.

It is to be hoped that those members who cannot attend the Congress will still become members of it by the payment of the required dues of 20 francs. The French language will probably be the principal language employed in the proceedings, but even so there can be no question that the record of these proceedings will be of a much greater value than the cost of membership. Those not attending the Congress can obtain the published record of its proceedings only by the payment of 20 francs as stated above. For the convenience of such members as wish to secure copies of these proceedings the Secretary has arranged to receive any remittances of $3.95 (the equivalent in American money of 20 francs) that may be sent him; attend to the forwarding to the Treasurer of the Commission of the money so received, with a list of the individual subscribers, and see that the record of the proceedings of the Congress reaches these subscribers as soon as possible after publication. It is desired that the members of our Association show their interest in this, the first International Congress of the Gas Industry, by enabling the Secretary to forward a large number of membership subscriptions.

Yours respectfully,

GEO. G. RAMSDELL, *President.*
ALFRED E. FORSTALL, *Secretary.*

INTERNATIONAL CONGRESS OF THE GAS INDUSTRY IN 1900.—REGULATIONS.

Article I. In accordance with a ministerial decree bearing date of the 11th of June, 1899, there is instituted at Paris, during the progress of the Universal Exposition of 1900, an International Congress of the Gas Industry.

Article II. The Congress will open the 2d of September in the Hall of Congresses at the Exposition; its duration will be about five days.

Article III. The membership of the Congress will consist of those persons who have sent notice of their desire to join to the President of the Commission of Organization before the opening of the session, or of those who register themselves as members during the time of the meeting, and who have paid the assessment, the amount of which is fixed at 20 francs.

The original members and the corresponding members of the Commission of Organization of the Congress, the administrative and technical staff of the Compagnie Parisienne du Gaz, the members of the Societe Technique de l'Industrie du Gaz en France, and those of foreign gas associations who pay annual dues to their respective societies are exempt from this payment of 20 francs, except that the last named will not receive free the publications and the minutes of the proceedings unless they are present at the Congress.

Article IV. Members of the Congress will receive a card of membership, which will be delivered to them by the care of the Commission of Organization.

These cards, which will give the right to enter into the Hall of Congresses by the door de l'Alma, are strictly personal; any card that is transferred will be immediately cancelled.

Article V. The Commission of Organization will cause to be made at the first session the nomination of the officers of the Congress, who will have direction of its labors.

Article VI. The Executive of the Congress will fix the order of the day for each session, regulate the discussions and revise the report of the proceedings.

Article VII. The members of the Congress alone have the right to assist at the meetings, to present papers and to take part in the discussions; they cannot have the floor for more than 15 minutes at a time, nor talk more than twice on the same subject during the same session unless the meeting by a vote decides otherwise.

Article VIII. The papers presented to the Congress on the questions placed upon the order of the day of the definite programme of the Commission of Organization will have priority, unless the Executive of the Congress gives a contrary decision.

Article IX. No paper or investigation can be presented during the session nor serve as a basis for a discussion unless the author has communicated its text, or an abstract of it, or at least the conclusions reached, to the Commission of Organization.

Article X. The members who have spoken in any session should hand to the Secretary résumés of their communications, to serve as aids to the correction of the report of the meeting. In case these résumés have not been handed in by a suitable time the text revised by the Secretary will stand.

Article XI. Summaries of the reports will be printed and distributed to the members of the Congress as soon as possible after the meeting.

Article XII. A full report of the work of the Congress will be published under the direction of the executive officers of the Commission of Organization.

Every member present at the Congress as well as every subscriber will be entitled to a copy of this report of the proceedings.

Article XIII. The executive officers of the Congress will decide without appeal upon all incidents not previously provided for and upon the proper interpretation of the regulations.

INTERNATIONAL CONGRESS OF THE GAS INDUSTRY IN 1900.—LIST OF QUESTIONS PROPOSED.

FURNACES AND SETTINGS—LABOR SAVING MACHINERY.

1. Settings for inclined retorts: The actual development and varying design in different countries; their use in large works. Compare the cost of installation of settings of inclined with that of settings of horizontal retorts; the economical result of this comparison reduced to a production of 35,000 cubic feet of gas per day; the opportunity for their employment in works of medium size; the comparison of the results of this system and those of drawing and charging machines from both the technical and economical points of view.
2. The mechanical drawing and charging of retorts and the applications of machinery in general for the operation of gas works.
3. Apparatus for the mechanical handling of coke.
4. Isolated generators at a greater or less distance from the settings and capable of feeding any setting. The advantages of this system.
5. The effect of regenerative benches upon the production of ammonia. The effect of anti-dips upon the production of ammonia.
6. The measurement of high temperatures.
7. The thermal reactions occuring during the distillation of gas coal.
8. The conditions to be observed in establishing a modern gas works.

PURIFICATION.

9. What is the best and most economical method of purifying gas? The choice of materials and the methods of handling.
10. The use of the spent purifying material.

BYE PRODUCTS.

11. The development during the second half of the century of the sale and the utilization of the bye-products of gas manufacture; and the principal causes of this development.
12. What progress has been made in the methods of producing yellow prussiate of potash in gas works, and what are the advantages of this production?
13. The production and manufacture of cyanides in a gas works.

CARBURETTING POOR GAS.

14. At what point should coal and water gas be mixed in a combination works to secure the best result?

STREET MAINS AND METERS.

15. Methods to be employed to obviate obstructions caused by naphthaline.
16. In what manner can the normal loss of gas in distribution be most largely diminished?
17. The advantages and disadvantages of dry meters and wet meters.
18. The results obtained in Holland with pre-payment meters.
19. The standardization of the screw threads to be employed on all pipes and fittings intended for use in connection with gas apparatus.

USE OF GAS.

(*a*) LIGHTING—HEATING.

20. The best methods to be employed to spread the use of gas for lighting, heating and motive power in competition with electricity and petroleum.
21. Improvements made in apparatus for heating and cooking.

(*b*) MOTIVE POWER.

22. A study of the actual condition of motors for ordinary gas and for lean gas.

MEASUREMENT AND YIELD OF LIGHT.

23. The adoption of an international photometrical standard and the method of using it.

24. The advisability of adopting a secondary standard, simple in construction, easily handled and giving quickly, results sufficiently exact to serve as a check upon the daily manufacturing results.

25. The photometry of incandescent gas lights.

26. Set forth from experiments specially made for this purpose, or from entirely new experiments, the principal causes to which the production of light by incandescent gas lights is due.

27. What are the relations between the illuminating value of an incandescent gas light and the lighting and heating power of the gas, all other things being equal? Consider a coal gas of which the candle power varies, for example, between 90 and 130 litres per carcel (16.5 to 12.2 candle power) or thereabouts.

28. A study of the composition of coal gas.

29. The influence of the color of nearby objects upon the diffusion of gas or other light.

30. A comparison of the cost of the light given by gas burners and incandescent electric lamps based upon the actual selling prices in different countries.

31. The same comparison with incandescent burners fed by cheap denatured alcohol.

32. A graphical comparison between the ordinary methods of lighting for equal amounts of light.

ECONOMICAL QUESTIONS.

33. A discussion of the systems employed for interesting stokers in the yield of gas from, and the economical use of fuel in the settings.

34. Professional instruction in the business of gas supply either for the purpose of educating men to the position of foremen of works or chief fitters, or for special supplementary instruction for the managers of works.

35. A statement of the results of the educational work carried on by the Trustees of the Gas Educational Fund.

United States Coal Production in 1899.

According to the returns representing between 80 and 90 per cent. of the total tonnage, the production of coal in the United States in 1899 is estimated by Edward W. Parker, statistician of the United States Geological Survey, to have amounted to 230,838,973 long tons, equivalent to 258,539,650 short tons. As compared with the production in 1898, when the output amounted to 196,405,935 long tons, or 219,974,667 short tons, this indicates an increase of over 34,000,000 long tons (or over 38,000,000 short tons), or 17.5 per cent. These figures exceed by 15,000,000 short tons the outside estimates heretofore made on the coal tonnage for 1899. The production of 220,000,000 short tons in 1898 was nearly 20,000,000 in excess of that of 1897, and both of these years were banner years in the industry.

It is not impossible that the figures for 1899, as estimated, may be somewhat reduced by later and more complete returns, and in fact this may be predicted as probable, but even a reduction of 5,000,000 tons would not amount to 2 per cent. of error in the total. The total value of this enormous product is estimated at $259,435,412, an increase of over $51,000,000, or practically 20 per cent. over the value of the product in 1898.

The part that anthracite coal played in this unprecendented production was an increase from 47,663,075 long tons, or 53,382,644 short tons, in 1898, to 53,857,496 long tons, or 60,320,395 short tons in 1899, with an increase in value from $75,414,537 to $88,123,493, a gain of nearly $13,000,000. Bituminous production (including semi-anthracite, semi bituminous, cannel, block and lignite coals), shows an increase of over 31,600,000 short tons, and a gain of nearly $39,000,000 of value. There were only three States that did not participate in the general increase. These were Arkansas, Georgia and Idaho. In the former the production was cut down by strikes which kept some of the largest mines idle a good part of the year. The decrease in Georgia was very small, and the entire product of Idaho has no effect on the total.

Another interesting and unusual feature of coal production in 1899 was the fact that there was an advance in prices, the first instance of the kind in ten years. The production of coal in 1898 and the estimated output for 1899 are shown in the following table:

	1898. Short tons.	1899. Short tons.
Alabama	6,535,283	7,234,558
Arkansas	1,205,479	911,342
California-Alaska	160,288	160,335
Colorado	4,076,347	5,425,618
Georgia and North Carolina	255,662	260,008
Idaho	1,039	20
Illinois	18,599,299	23,434,445
Indiana	4,920,743	6,529,826
Indian Territory	1,381,466	1,677,100
Iowa	4,618,842	5,265,480
Kansas	3,406,555	3,948,197
Kentucky	3,887,908	5,120 370
Maryland	4,674,884	5,516 363
Michigan	315,722	523,084
Missouri	2,688,321	3,833,546
Montana	1,479,803	1,956,300
New Mexico	992,288	1,200,668
North Dakota	83,895	116 929
Ohio	14,516,867	16,679,880
Oregon	58,184	90 302
Pennsylvania	65,165,133	75,591,554
Tennessee	3,022,896	3,361,465
Texas	686,734	938,765
Utah	593,709	787,258
Virginia	1,815,274	2,332,627
Washington	1,884,571	2,020,260
West Virginia	16,700,999	18,755,222
Wyoming	2,863,812	4,547,733
Total bituminous	166,592.023	198,219,255
Pennsylvania anthracite	53,382,644	60,320,395
Grand total	219,974,667	258,539,650

A New Hydrocarbon Cuprene.

The *Scientific American* says that it has been recently shown by Messrs Sabatier and Senderson, of Paris, that acetylene has a marked action upon copper in a finely divided state, and they have obtained a new product in the shape of a solid hydrocarbon. Pure and dry acetylene gas is made to pass through a tube containing a certain quantity of reduced copper in the form of a fine powder. When the copper is heated to about 180° C. it absorbs the gas with great rapidity. In one experiment a current of gas, having a velocity of 20 cubic centimeters per minute, was entirely interrupted for more than 20 minutes, due to its absorption by the copper; after a time the current of gas is re established, but slowly at first. During the first part of the action a colorless liquid is condensed upon the cold parts of the tube, consisting especially of ethylenic carbides; the microscope shows that the copper has not as yet changed; but as the current of gas re-establishes, the copper begins to swell rapidly, assuming a lighter color and soon fills the tube entirely, closing off the passage of the gas. At this stage the liquid hydrocarbons condensed in the tube have a greenish color and appear to consist of a mixture of hydrocarbons of the ethylene and the aromatic series. They give with concentrated sulphuric acid an intense red coloration, and become gradually solid upon exposure to air. As to the gases which leave the tube, analysis shows that they are formed of a mixture of hydrogen, ethylene, propylene, etc. The same reactions may be obtained by using copper in the form of foil or wire, this being heated in a current of acetylene to 200–250° C. The copper becomes covered with a layer which is at first brown, then becomes yellow as its thickness increases. If a part of the brown substance is taken and heated in a tube in a current of the gas, it soon begins to swell, and may fill the whole of the tube. This process is recommenced until no further swelling is observed, and a substance is finally obtained which is not modified by the gas. This product is a yellowish solid more or less dark in color, which, under the microscope, appears to consist of an assemblage of very fine filaments intermingled. The mass may become adherent by a slight pressure, like asbestos, which it somewhat resembles in appearance. It burns with a short and smoky flame, giving off an aromatic odor and leaving a slight residue of copper oxide. This body is a hydrocarbon in whose mass is found the small quantity of copper which has contributed to its formation; the proportion of copper is small, being but 2 or 3 per cent. The product has a definite composition, and analysis gives the empirical formula C_4H_3. On account of its origin the experimenters proposed to give the name of cuprene to this new hydrocarbon. It seems to have no appreciable volatility, and when heated it decomposes above 400° C., giving off gases and leaving a carbonaceous residue. This body seem to be almost insoluble; sulphuric acid has no appreciable action upon it, and nitric acid attacks it but slowly. The experimenters propose to continue their investigations upon this singular body.

A Chapter on Electrical Instruction.

By Mr. Harry L. Tyler, in *Electrical World*.

"The method of instruction by analogues is always a dangerous one * * * In the case of electricity, the danger is specially great when its etheric phenomena are illustrated with reference to phenomena of ponderable matter."—Editorial in *Electrical World and Engineer*, March 24, 1900.

If many electrical writers and speakers were to memorize the foregoing editorial before undertaking the instruction of the uninformed, much havoc would be undone. Contrary to popular belief, electrical science is by no means in its infancy. Yet many writers persist in the use of old phrases that sustain the popular fallacies rather than the un popular facts; and the unwary reader that has been afflicted with them is quite likely to believe anything and everything that may be said of electric things. It seems to be the lot of many of us to labor over analogues, and then rest with the impression that electrification is—no one knows what!

In the early days of electrical science—and history shows that they were days when superstition was mightier than reason—the effects of electrification seemed indicative of some infernal fluid that was believed to flow through electrified bodies. Some investigators believed that there were two kinds of fluid—positive and negative—and that a union of both was necessary to a realization of either. Others believed in but one kind of fluid. These argued that quantities of the fluid lay normally at rest in some substances (silver, copper and the like) and that it did not exist at all in substances such as glass and rubber.

Thus was formed a great bugaboo—the table of conductors and non-conductors—which is still in press, notwithstanding that it is a misconception from beginning to end. Then arose the deplorable custom of teaching that "a current of electricity will flow from one body to another or from place to place in the same body if suitable means be provided to maintain the circulation by returning the electricity to its starting point."

In these days the falseness of either the two fluid theory or the current-flow theory cannot be overstated. Yet the current flow theory is continually appearing beside the picture of a water pump or an air pump with its outlet marked + and its intake marked —, as an illustration of what an electric generator is like. Instead of learning what electric generators, circuits and such things are like, or rather what people once thought they were like, let us learn what they are.

In his little experience of helping station men, railway men and the like in the study of electrical science, the writer has always kept in mind this golden rule: All words, terms and phrases that signify the transportation of something are misused if used at all in an electrical sense. Thus accordingly have been avoided these terms: resistance; hindrance; electromotive force; potential; pressure; tension; current; quantity; fluid; rate of flow. In following this policy no new words have to be coined. The simple little words omage, voltage and amperage are always preferable to any of the foregoing; and they lose none of their force in repetition.

In the making of any change there are involved three factors—persistence, effort and degree. Thus from an electrical point of view all matter has a persistence to stay unelectrified, which is called ohmage; in electrifying anything an effort to electrify is required, which is called voltage; when an effort is made to electrify anything the result is qualitative (not quantitative), and the degree of electrification is called amperage. The respective units are the ohm, the volt and the ampere.

In referring to circuits, dynamos, motors, meters and the like, we have reason to be careful of our diction. For instance, the propriety of the phrase "direct current" before any noun is questionable. The word "direct" is not, as many seem to think, opposed to the word "alternating." What is there that is not direct about alternating circuits? Surely the right word to use is "continuous;" for that is what we mean when we make the error of using "direct." As for the word "current," that is altogether superfluous in whatever place we use it in an electrical sentence. It is pleasing to note that several advertisers are omitting the word. How much better is is to read of "continuous dynamos;" "motors for continuous circuits;" "meters for alternating circuits;" "alternating arc lamps," and the like.

As far as electric "conductors" and "non-conductors" are concerned, we are unwarranted in speaking of such things. No substance is conducted through a body during its electrification, so electrified bodies are not "conductors." There is no substance that cannot be electrified, so there are no "non-conductors."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. J. W. Stratton, formerly connected with the Valparaiso (Ind.) Company, has purchased an interest in and assumed the management of the Creston (Iowa) Gas and Electric Company. Mr. Stratton proposes to put the Creston plant in good shape for the work that it has to perform, and that proposition involves him in a busy summer.

Mr. H. H. Kelly, formerly in charge of the Chelsea (Mass) works, assumed charge of the plant at Ottawa, Ills., the 1st inst.

Mr. Robert W. Prosser, writing to the Journal, under date of New York, April 30th says: To the Editors American Gas Light Journal: As the question, "How much steam is required to make 1,000 cubic feet of water gas?" asked at the last meeting of the Ohio Gas Light Association, did not receive a very definite answer I venture to send the following: 1,000 cubic feet of non-illuminating water gas contains theoretically 500 feet of CO and 500 feet of hydrogen. The weight of the 500 feet of CO, at 60° F. and 760 mm. (29 92 inches) pressure, on the authority of Prof. Julius Thomsen, is 258,615 grains, of which three-sevenths (or 110,835 grains) is carbon, and four sevenths (or 147,780 grains) is oxygen. The weight of the 500 feet of hydrogen in 18,472 (Thomsen, 18,520) grains, which is one eighth of the oxygen, or in the proportion to form water. The weight of the water or steam will, therefore, be 18,472 + 147,780 = 166,252 ÷ 7,000 = 23.75 pounds. Practically the hydrogen is always in excess of the carbonic oxide in water gas, as carbonic acid is formed which absorbs more oxygen without increasing the volume, and sets free more hydrogen which does increase it. This requires a further amount of steam, and if the gas is measured after purification and removal of CO_2 a still greater quantity of steam will be required. Other practical losses are steam blown through the generator without decomposition, that used for purging, and loss from condensation and waste, which bring the quantity required up to about twice that theoretically necessary. If the question is intended to refer to illuminating water gas the quantity of steam per 1,000 cubic feet will be reduced, by the percentage volume of the gas which is made from the oil. This varies from 20 to 33 per cent. In Mr. Alten S. Miller's paper, published in the Journal for October 23, 1899, he gives as steam used in generator 29½ pounds. If his gas contains 30 per cent. of volume due to the oil used, this would be equal to about 42 pounds per 1,000 cubic feet for straight water gas.

The American Meter Company has removed its headquarters to its new factory building, Eleventh avenue and 47th street. In time we hope to give a detailed description of the Company's new plant, which is well worth visiting.

The proprietors of the Manchester (Va.) Light, Heat and Power Company are said to be in the field for bids for construction work and apparatus on the proposed gas plant for that city.

The Sarnia (Can.) Gas and Electric Light Company will largely increase the electric lighting plant that it maintains.

A correspondent encloses the following: "The La Crosse (Wis) Gas Light Company announces that, after May 1, the price of gas will be advanced. In a circular letter to its patrons the Company says it was hoped that the high price of coal which prevailed during last year would be only temporary and that the price of gas would not be affected. The recent strong combination among the mine owners of the Youghiogheny district of Pennsylvania, and the consequent advance of about 35 per cent. in the price of coal, have compelled it to advance the price of gas. This course is further rendered imperative by the fact that for some time the Company has failed to earn enough to pay operating expenses and fixed charges. The rates on and after May 1st will be: On illuminating account, $1.75 per 1,000 cubic feet; for fuel use, $1.40 per 1,000."

The Hopkinsville (Ky.) Gas and Lighting Company has purchased the plant and franchises of the Hopkinsville Water, Light and Power Company, and is now operating the electric lighting plant. The gas plant still remains in the hands of Mr. T. G. Littlehales, Lessee, to whom all matters pertaining to the gas part of the Company's business should be addressed.

Mr. W. B. Nyce, Secretary of the Keystone Meter Company, of Royersford, Pa., writing under date of April 30th, informs us that the Company has established a repair shop at No. 22 Second street, San Francisco, Cal., which shop is under the management of its Pacific Coasts Agents, Messrs. Wiester & Co. The shop is equipped with

thoroughly modern apparatus, and it has been manned with employees direct from the Company's eastern shops. The Company has been awarded the contract for building a 14 foot station meter drum for the Standard Gas Light Company, of New York. According to the contract the work is to be completed in 7 weeks.

RECENT advices by way of Camden, N. J., are as follows: "The American Investment Company has purchased the Gloucester City (N. J.) electric light plant, and commenced to operate the same on the 1st inst. The American Investment Company is the corporation that owns and operates the gas and electric light plants in Woodbury, Merchantville, Moorestown and Mount Holly."

MR. CHARLES W. STARR, for many years Treasurer and Secretary of the Consumers Gas Company, of Woodbury, N. J., died at his home in Woodbury the evening of April 24th. He was in his 61st year.

THE regular quarterly dividend of 2½ per cent. on the shares of the Municipal Gas Company, of Albany, N. Y., has been payable since the 1st inst.

THE Johnstown (Pa.) *Tribune* says that though not entirely completed yet, the new plant of the Consumers Gas Company in the Sixteenth Ward of Johnstown has for some weeks been supplying a portion of the illuminating gas furnished in that city, and within a month the old plant near the Penn Traffic Annex will be dismantled. The site of the old plant has been purchased from the Gas Company by the Cambria Steel Company, and will form a part of the Cambria's yards as soon as the machinery and buildings can be removed.

AT the reorganization meeting of the Wilmington (N. C.) Gas Light Company the officers elected were: Directors, W. W. Randolph, H MacRae, George R. French, G. H. Smith, W. L. Parsley, M. J. Heyer and Junius Davis; President, Hugh MacRae; Secretary and Treasurer, R. J. Jones; Superintendent, E. G. Boeklin; Consulting Engineer, W. W. Randolph.

MESSRS. A. L. Anderson and H. L. Olds, of Lincoln, Ills., have sold to Mr. W. H. Odiorne, of Springfield, Ills., all their interest in the franchise granted to them for the construction and operation of a gas works at Clinton, Ills.

THE Ridgewood Gas Company, to transact a "general illuminating business" in Ridgewood, Bergen county, N. J., has been incorporated with an authorized capital of $100,000.

AT a meeting of the San Bernardino (Cal.) Board of Trade Messrs. J. H. Boyd, James Flemming and Frank M. Towne were appointed a committee to investigate and report on the cost of constructing and operating a gas and electric lighting plant on municipal account.

ACCORDING to the returns submitted to the authorities of Philadelphia, by the United Gas Improvement Company, in connection with its operation of the Philadelphia gas works, the amount of gas sold during the quarter ended March 31st was 1,158,757,600 cubic feet.

THE Citizens Gas Company, to operate gas, electric light and water plants in Kankakee, Ills., has been incorporated by Messrs. Edward L. Barr, J. F. Leake and G. B. Foster. -It is capitalized in $150,000.

A CORRESPONDENT in Baltimore, Md., forwards the following, under date of the 27th of April: "The Hagerstown (Md.) Light and Heat Company to day passed into the hands of the new management. The following officers were elected: Directors, W. C. Hepperle, Andrew K. Black, Albert Heard, Christian W. Lynch and William Jennings; President, C. W. Lynch; Treasurer, Wm. Jennings; Secretary, Albert Heard. Mr. Lynch succeeds Mr. Henry Steck, of Philadelphia, as President, and Mr. Jennings succeeds Mr. Albert Heard as Treasurer. The latter is the only one of the old Board retained. This puts the gas and electric lighting and the street railway business of Hagerstown in control of a single interest."

AT the annual meeting of the Painesville (Ohio) Gas, Light and Coal Company the officers chosen were: Directors, S. R. King, J.W. Alexander, C. C. Viall, C. H. Frank and G. P. Steele; President and Secretary, G. P. Steele; Vice President, S. R. King; Treasurer, C. H. Frank.

IT does not seem likely that Belleville, Ills., is about to undertake the operation of a lighting plant on municipal account, for the Council last month awarded a contract for the public lighting of the city to the Belleville Gas Light and Coke Company. This contract is to follow the expiration of the present one, which does not end by limitation until some time next fall.

THE reorganization of the gas and electric lighting interests of Winchester, Va., which has been perfected by the amalgamation thereof in a corporation to be known as the Winchester Gas and Electric Light Company, was completed about a fortnight ago. The officers elected were: Directors, Charles H. Dickey, W. M. Murray, John H. Cunningham, James B. Russell and W. S. Love; President, Charles H. Dickey; Vice President, W. M. Murray; Secretary and Treasurer, James B. Russell; Manager, John H. Cunningham; Supt., John B. Shull.

THE public street lighting of Baltimore, Md., at the present time requires a total of 8,708 lamps of all sorts. The lamp service is thus divided: Arc electric, 1,391; gas, 6,232; gasoline, 1,085.

AT the annual meeting of the Columbus (Ohio) Gas Company the following officers were elected: Directors, Irvin Butterworth, F. C. Hubbard, D. E. Putnam, C. D. Firestone, George W. Sinks, H. D. Turney, E. K. Stewart, J. O Johnston and John G. Desbler; Presiden, Irvin Butterworth; First Vice-President, F. C. Hubbard; Second Vice-President, D. E. Putnam; Secretary, Charles S. Ritter; General Superintendent, J. O. Johnston.

"AT a recent meeting of the City Council, of Lincoln, Ills., bids for the public street lighting were opened and considered. The City of Lincoln Gas Company, through its Superintendent, Mr. H. L. Olds, agreed to furnish any required number of Welsbach gas lamps, to be lighted every night and all night, and any number of lamps to be lighted from dark to midnight, at a certain sum for each branch of the service. The Council awarded the contract to the Gas Company.—F."

THE above is a very unsatisfactory correspondence item, and is only printed to show how incomplete such an item can be. What were the prices agreed upon? How long is the contract to run? Does the city maintain the lamps, light and extinguish the same, etc.? Not a word do we get on these points. However, as said before, the item is printed merely to show what it does not contain.

MR. S. R. BURTON has been elected to the vacancy in the Board of Directors of the Cincinnati Gas Light and Coke Company caused by the resignation of Mr. Robert Allison.

AT the annual meeting of the Savannah (Ga.) Gas Light Company the officers elected were: Directors, John C. Rowland, Jacob Raners, J. H. M. Clinch, William M. Low, H. H. Gilmer, J. F. Minis, C. S. Connerat, A. R. Lawton and A. G. Guerard; President and Treasurer, A. G. Guerard.

THE *Gas World* says that the Directors of the South Metropolitan Gas Company (London), as was to have been expected, recognize quite as clearly as the many other people by whom the fact has been pointed out, that an advance of 6 cents per thousand cubic feet in the price of gas does not exhaust the possibilities of the situation created by the famine prices that are being demanded for coal. Along with their quarterly accounts the gas consumers within the Company's area of supply have received a circular, signed by Mr. Frank Bush, the Secretary, in which they are informed that "the Company's coal contracts, free on board in the Tyne, made a year ago, were at a material—about 20 per cent.—advance, which has been to a considerable extent met by increased receipts for coke. The coal contracts expire this month, and the prices demanded for Newcastle gas coal are 100 per cent. in excess of those of last year, and, unfortunately, little if any further advance in the value of coke can be expected. The greater part of the burden must, therefore, fall upon the gas consumers. To meet the extra cost of coal not less than 16 cents per thousand cubic feet is necessary, but in the hope that the present extreme price of coal may not be maintained throughout the ensuing twelve months, the directors have resolved to try a moderate advance of 6 cents, making the price 58 cents per 1,000 cubic feet." The directors state that they feel this explanation is due to the consumers because the sliding scale makes them partners with the shareholders, losses and gains being shared. It is added that "the directors will not increase the price of gas more than is necessary, and that they will reduce it again as soon as possible.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,

PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,

EDITORS.

CHAS. E. SANDERSON,

MANAGER.

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AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, MAY 7, 1900.

The Market for Gas Securities.

The market for city gas shares was absolutely flat last week save for a shortlived spurt in Consolidated, which buoyancy lasted about two hours. The opening to day (Friday) was made at precisely the same figures which marked the closing last Friday—183½ to 185. Everybody seems at sea over the warfare, but that it is still on is shown by the selling rate. New Amsterdams are dull and weak and a like remark applies to Standards. The New York By-Product Coke Company, to manufacture and sell coal, coke and their by-products "in the neighborhood of New York city," is not taken very seriously by the local gas interests. The concern is capitalized in $6,000,000, and includes in its directorate Messrs. John A. Young, H. D. Benner, R. C. Pruyn, L. H. Hendricks and John W. Hardenbergh. Those interested in the local situation have only to watch and pray.

Brooklyn Union gas is in some demand, and remains well up to recent quotations. We repeat our recent opinions regarding its prospective value. Peoples, of Chicago, is steady, and Baltimore Consolidated moved up sharply within the week to 56, and it will go higher. San Francisco Gas and Electric is down to 50. Bay State is gradually getting to one.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MAY 7.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	183½	185
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	275	300
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000			
New Amsterdam Gas Co.	13,000,000	100	27	28½
Preferred	10,000,000	100	49	52
Bonds, 5's	11,000,000	1,000	97	98
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000		115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000		
Standard	5,000,000	100	100	116
Preferred	5,000,000	100	125	140
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	150	153
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1¼	1⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	35
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	77½
2d " " "	3,000,000	1,000	42	45
Buffalo City Gas Co.	5,500,000	100	5	6
" " Bonds, 5's	5,250,000	1,000	69	71
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,090	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	195¾	196½
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	55	56
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	19
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	101	103
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co.	250,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Lafayette Gas Co., Ind.	1,000,000	100	40	45
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Laclede, St. Louis	7,500,000	100	70	70¼
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	110	110½
Madison Gas & Elec. Co.	400,000	100	82	..
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
Essex and Hudson Gas Co.	6,500,000	..	35	40
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	104	104½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111½
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	49¾	50
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	15
Bonds	1,612 000	1,000	85	90
Washington, D. C	2,600,000	20	271	272
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	..	92
Bonds, 5's	3,830,500	.	104	106
Wilmington, Del.	600,000		2 0	50

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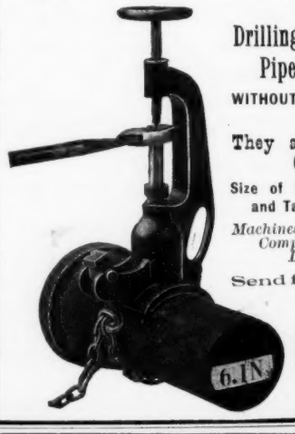

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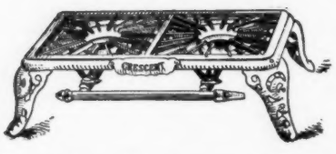

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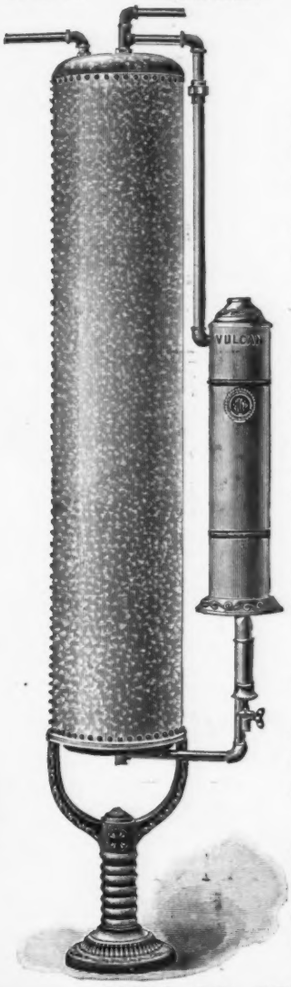

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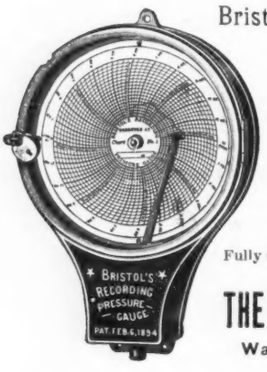

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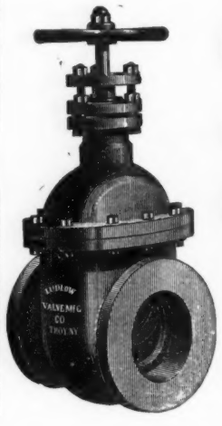

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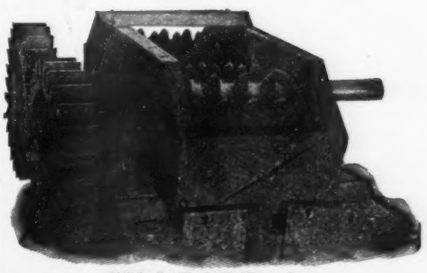

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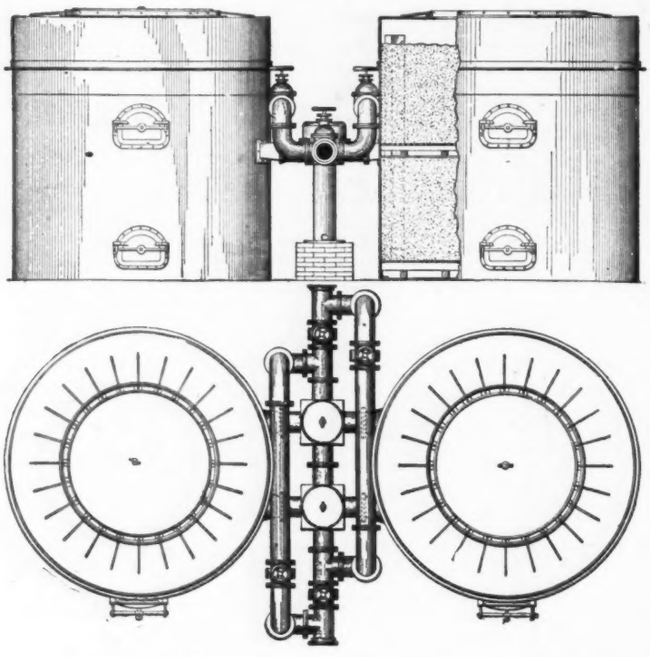

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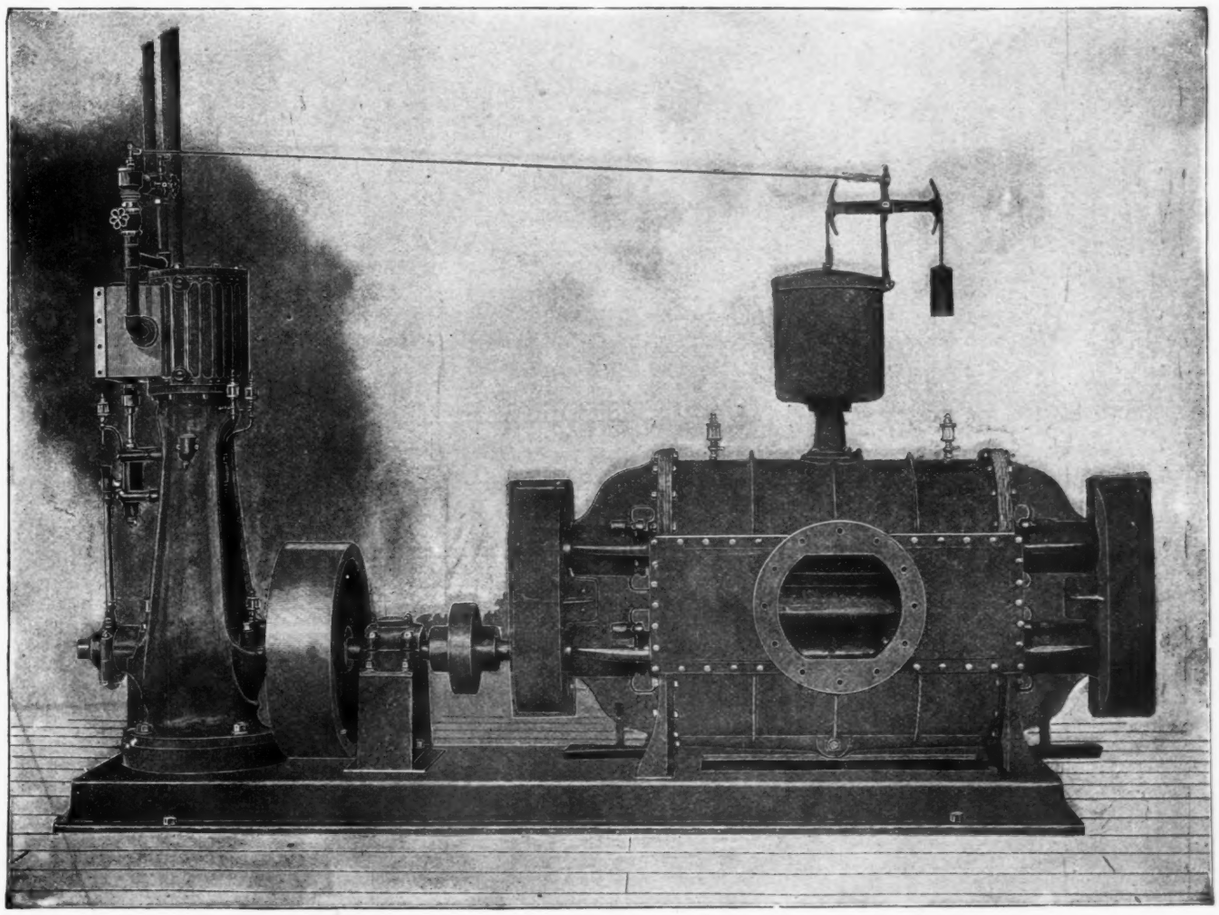

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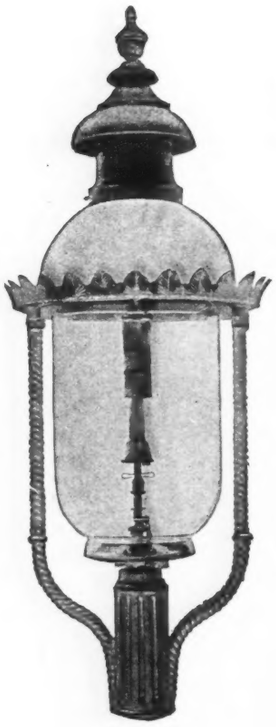

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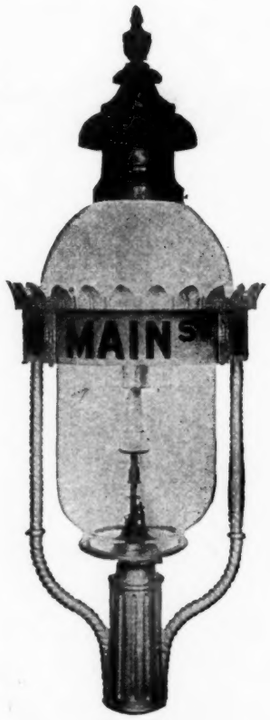

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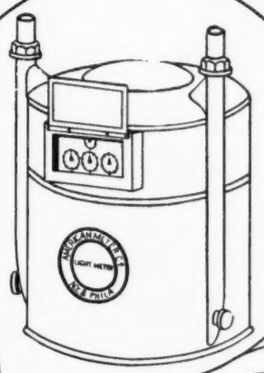

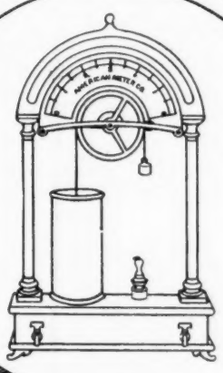

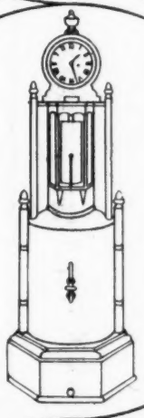

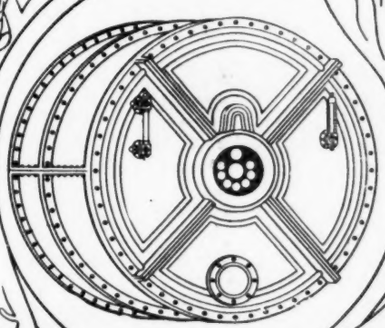

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

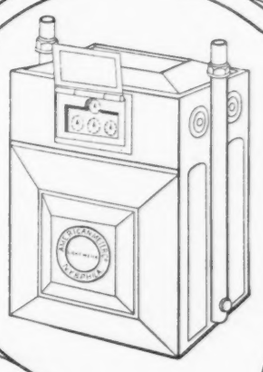
PUBLIC LIGHTING TABLE.

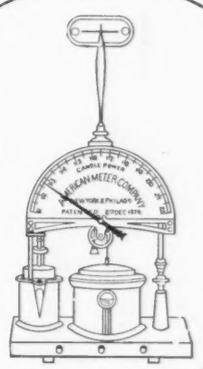
MAY, 1900.

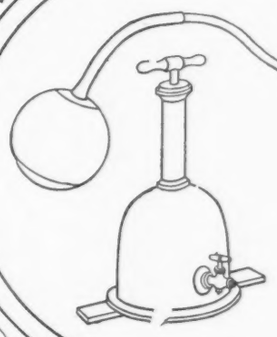
Day of Week.	Table No. 1. Following the Moon.			Table No. 2. New York City. All Night Lighting.	
	Date.	Light.	Extinguish.	Light.	Extinguish.
				P.M.	A.M.
Tue.	1	7.20 PM	4.00 AM	6.45	4.00
Wed.	2	7.20	4.00	6.45	4.00
Thu.	3	10.30	4.00	6.45	4.00
Fri.	4	11.10	4.00	6.45	4.00
Sat.	5	11.40	4.00	6.45	4.00
Sun.	6	12.10 AM FQ	3.50	6.45	4.00
Mon.	7	12.40	3.50	6.55	3.40
Tue.	8	1.00	3.50	6.55	3.40
Wed.	9	1.30	3.50	6.55	3.40
Thu.	10	1.50	3.50	6.55	3.40
Fri.	11	2.20	3.50	6.55	3.40
Sat.	12	2.50	3.50	6.55	3.40
Sun.	13	No L.	No L.	6.55	3.40
Mon.	14	No L. FM	No L.	7.00	3.30
Tue.	15	No L.	No L.	7.00	3.30
Wed.	16	7.40 PM	10.20 PM	7.00	3.30
Thu.	17	7.40	11.10	7.00	3.30
Fri.	18	7.40	11.50	7.00	3.30
Sat.	19	7.40	12.30 AM	7.00	3.30
Sun.	20	7.40	1.10	7.00	3.30
Mon.	21	7.40 LQ	1.40	7.10	3.15
Tue.	22	7.40	2.10	7.10	3.15
Wed.	23	7.40	2.40	7.10	3.15
Thu.	24	7.40	3.20	7.10	3.15
Fri.	25	7.40	3.40	7.10	3.15
Sat.	26	7.40	3.40	7.10	3.15
Sun.	27	7.50	3.30	7.10	3.15
Mon.	28	7.50 NM	3.30	7.15	3.15
Tue.	29	7.50	3.30	7.15	3.15
Wed.	30	7.50	3.30	7.15	3.15
Thu.	31	7.50	3.30	7.15	3.15

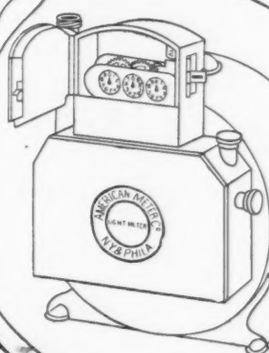
TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45









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The name on the mantle—
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THE STANDARD JUNIOR,

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LOWE WATER GAS APPARATUS.

Total Sets Installed to January 1, 1900, - - - - - - - - 327

Total Daily Capacity - - - - - - - - - 207,425,000 Cu. Ft.

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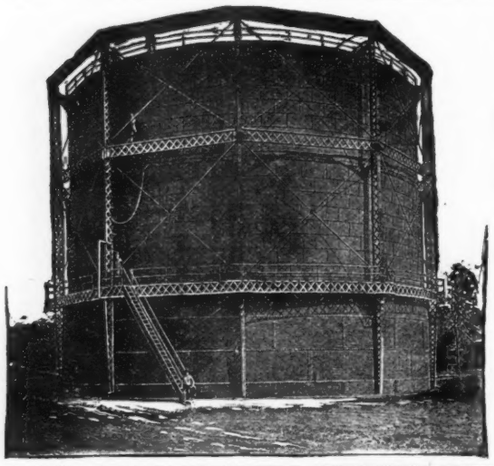

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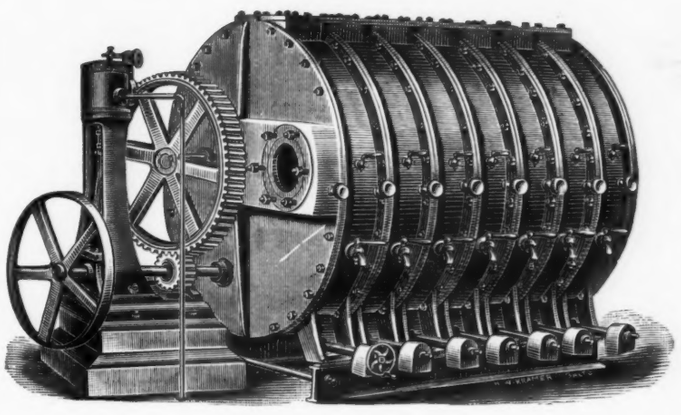

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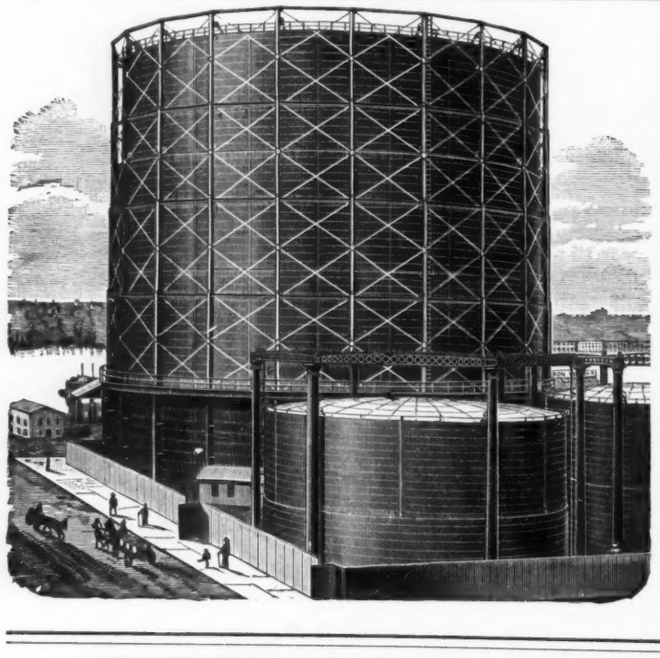

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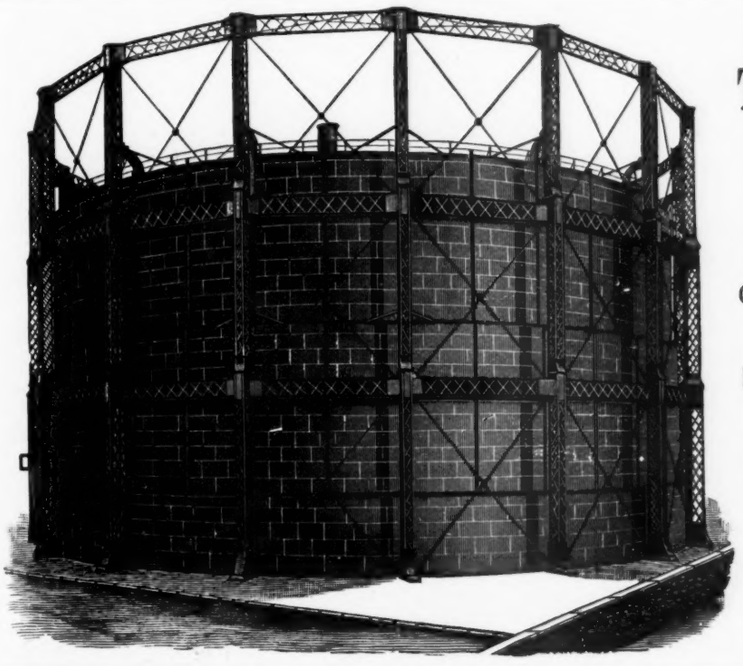

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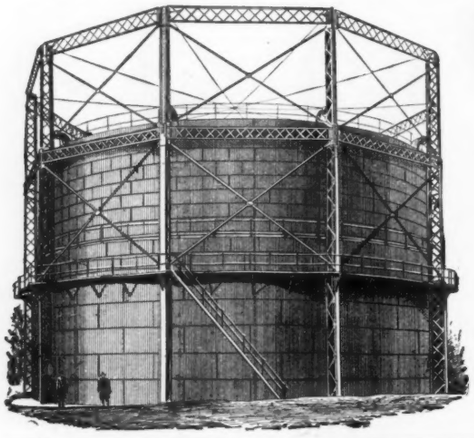

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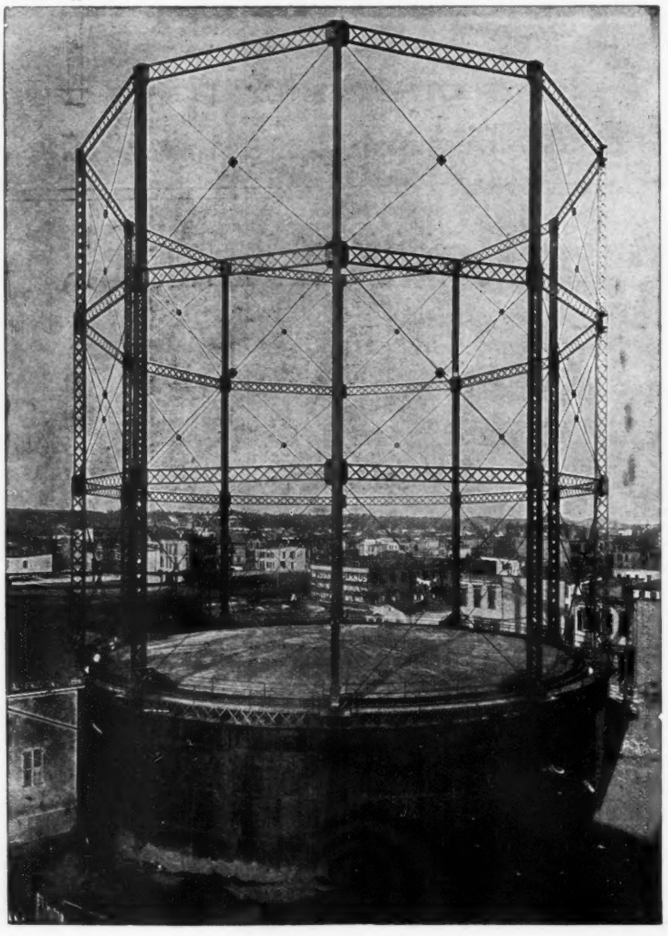

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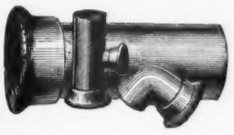

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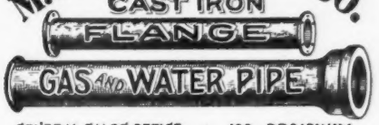

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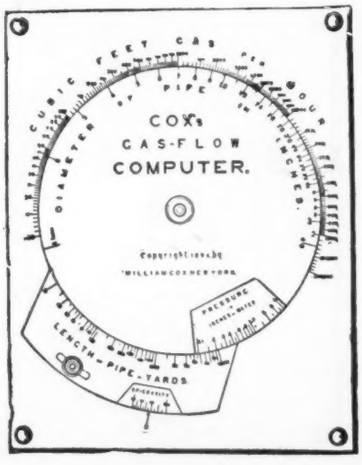

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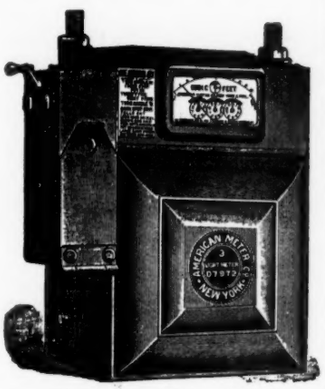

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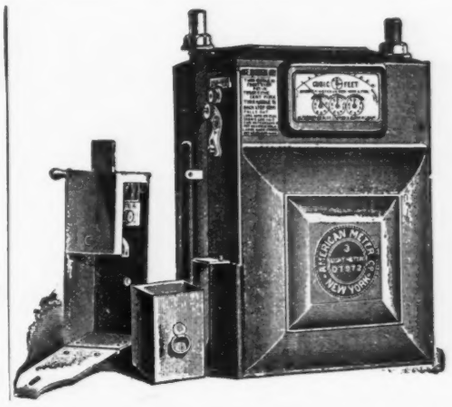

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